National Security Technologies LLC

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HYDROGEOLOGIC CHARACTERIZATION OF THE U-3bl COLLAPSE ZONE

September 2006

National Nuclear Security Administration

This work was done by Bechtel Nevada and National Security Technologies, LLC, under Contract Numbers DE-AC08-96NV11718 and DE-AC52-06NA25946, respectively, with the U.S. Department of Energy.

DISCLAIMER STATEMENT

AVAILABILITY STATEMENT

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Hydrogeologic Characterization of the U-3bl Collapse Zone

Prepared by
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Las Vegas, Nevada

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ABSTRACT

The U-3bl collapse crater was formed by an underground nuclear test in August 1962. This crater and the adjoining U-3ax crater were subsequently developed and used as a bulk low-level radioactive waste disposal cell (U-3ax/bl), which is part of the Area 3 Radioactive Waste Management Site at the Nevada Test Site (NTS). Various investigations have been conducted to assess the hydrogeologic characteristics and properties in the vicinity of the U-3ax/bl waste disposal cell. This report presents data from one of these investigations, conducted in 1996. Also included in this report is a review of pertinent nuclear testing records, which shows that the testing operations and hydrogeologic setting of the U-3ax/bl site were typical for the period and location of testing.

Borehole U-3bl-D2 is a 45-degree-angle hole drilled from the edge of the crater under the waste cell to intercept the U-3bl collapse zone, the disturbed alluvium between the crater (surface collapse sink) and the nuclear test cavity. A casing-advance system with an air percussion hammer was used to drill the borehole, and air was used as the drilling fluid. Properties of the U-3bl crater collapse zone were determined from cores collected within the interval, 42.1 to 96.6 meters (138 to 317 feet) below the ground surface. Selected core samples were analyzed for particle density, particle size, bulk density, water retention, hydraulic conductivity, water content, water potential, chloride, carbonate, stable isotopes, and tritium.

Physical and hydraulic properties were typical of alluvial valley sediments at the NTS. No visual evidence of preferential pathways for water transport was observed in the core samples. Soil parameters showed no trends with depth. Volumetric water content values ranged from 0.08 to 0.20 cubic meters per cubic meter, and tended to increase with depth. Water-retention relations were typical for soils of similar texture. Water potentials ranged from -1.9 MegaPascals at a depth of 42.10 meters (138 feet) to -0.4 MegaPascals at 94.58 meters (310 feet), generally increasing with depth. Relationships between hydraulic conductivity and water content were typical of sandy soil, with hydraulic conductivity decreasing rapidly as the soil dried. Variability of hydraulic conductivity reflected layering and showed no trend with depth.

Stable isotope compositions were typical of water that had infiltrated during cooler past climate conditions. Uniformity of concentrations versus depth indicated that evaporation was not occurring at the sampled interval. Tritium concentrations in pore water ranged from 2.68×10^3 to 1.22×10^4 picoCuries per liter, which are greater than expected from atmospheric deposition of tritium, but not at a level to raise environmental concerns. The tritium is most likely a product of nuclear testing.

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PREFACE

This report is a reissue of a limited-distribution Bechtel Nevada (BN) data report approved for formal publication. National Security Technologies, LLC (NSTec) prepared this revision for publication in order to provide broader access to the data and to facilitate closure planning for the Area 3 Radioactive Waste Management Site (RWMS) at the Nevada Test Site (NTS). Although the report has been revised slightly to conform to current editorial standards of NSTec and the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office (NNSA/NSO), the data and interpretations contained within have not changed. The abstract, preface, list of acronyms and abbreviations, and introductory paragraphs have been added for clarity and improved user friendliness.

With the exception of the location maps (Figures 1 and 2), most of the graphics have not been updated. Many of the engineering drawings, figures, and tables in Attachment A are reproductions of records from 1962. In some cases, the original record was in poor condition or only a poor quality reproduction of the original was available. Similarly, some of the summary figures and tables from the 1998 report in Attachments C and D are reproductions from paper copies because electronic files were inaccessible. The best available copy of each item was used to produce this report. The history of the document and its relationship to other investigations and DOE publications follows.

Characterization of the U-3bl collapse zone was one of a series of investigations conducted by the Special Projects Section of Reynolds Electrical & Engineering Company, Inc. (REECo) and BN in the 1990s to characterize the upper vadose zone hydrogeology of the Area 3 RWMS at the NTS for the DOE Nevada Operations Office. REECo and BN documented the results in several limited-distribution data reports that were not formally approved by DOE for public release. To facilitate broader access to this data, BN began submitting these older REECo and BN reports through the DOE's Scientific and Technical Information Product review process for formal publication. NSTec succeeded BN in July 2006, and is continuing this publication effort for the NNSA/NSO, the successor to the DOE Nevada Operations Office.

BN transmitted the *Hydrogeologic Characterization of the U-3bl Collapse Zone* report as a communication to the DOE Nevada Operations Office in November 1996. The report was later reissued as one of several data report attachments to the BN February 1998 limited-distribution report, *Hydrogeologic Characterization of the Unsaturated Zone at the Area 3 Radioactive Waste Management Site*, DOE/NV/11718--210. Although the nested reports received document numbers, they were not formally released by DOE for publication. The attached reports included:

- *Hydrogeologic Characterization of U-3at Collapse Zone: Data Report* (DOE/NV/11718--199)
- *Hydrogeologic Characterization of U-3bh Collapse Zone: Data Report* (DOE/NV/11718--198)
- *Hydrogeologic Characterization of U-3bl Collapse Zone: Data Report (*DOE/NV/11718--197)

To reduce confusion and citation errors, these three 1998 data reports are being published as separate documents. BN revised the U-3at data report, which was published as DOE/NV/11718--199 REV 1 in 2005, and NSTec expects to publish the U-3bh report concurrently with this U-3bl report in 2006.

Data in this report supplement the U-3bl characterization data presented in the BN August 2005 report, *Site Characterization Data from the U3ax/bl Exploratory Boreholes at the Nevada Test Site,* DOE/NV/11718--003-REV.1.

Summary data from these studies are also included in the *Performance Assessment/Composite Analysis for the Area 3 Radioactive Waste Management Site, Nye County, Nevada*, Revision 2.1, DOE/NV--491-REV 2.1, prepared by G. J. Shott, Y. Yucel, M. J. Sully, L. E. Barker, S. E. Rawlinson, and B. A. Moore, and published in October 2000.

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List of Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
bgs	below ground surface
BN	Bechtel Nevada
CA	Composite Assessment
CAU	casing-advance under-reaming
cm	centimeter(s)
δ	delta
D	deuterium
δD	parts per thousand enrichment or depletion of deuterium : protium relative to the proportion in SMOW
$\delta^{18}O$	parts per thousand enrichment or depletion of ^{18}O : ^{16}O relative to the proportion in SMOW
DOE	U.S. Department of Energy
ft	foot (feet)
ft^3	cubic feet
in.	inch(es)
kg/m^3	kilogram(s) per cubic meter
LMWL	Local Meteoric Water Line
m	meter(s)
m^3	cubic meter(s)
mg/kg	milligram(s) per kilogram
mm	millimeter(s)
MPa	MegaPascal(s)
m/s	meters per second
NESTT	Northwest Environmental Services, Testing, and Training
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NSTec	National Security Technologies, LLC
NTS	Nevada Test Site
^{16}O	oxygen-16
^{18}O	oxygen-18
OD	outside diameter
PA	Performance Assessment
$^0/_{00}$	parts per thousand
RWMS	Radioactive Waste Management Site
SMOW	Standard Mean Ocean Water

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1.0 INTRODUCTION

The work described in this document was conducted in the 1990s by personnel of Reynolds Electrical and Engineering Company, Inc., and Bechtel Nevada (BN) at the Nevada Test Site (NTS). This study was one of several hydrogeologic characterization studies of the upper vadose zone at the Area 3 Radioactive Waste Management Site (RWMS) conducted for the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office (NNSA/NSO; formerly U.S. Department of Energy, Nevada Operations Office), Waste Management Project.

This document is an update of the February 1998 data report prepared by BN, which was presented as an attachment in a limited-distribution report, *Hydrogeologic Characterization of the Unsaturated Zone at the Area 3 Radioactive Waste Management Site* (DOE/NV/11718--210). BN first submitted the limited-distribution report as a separate communication to DOE in November 1996.

Although the report has been revised slightly for clarity and to conform to current editorial standards of National Security Technologies, LLC (successor to BN), and NNSA/NSO, the data and interpretations have not changed. No new data have been added to this report, although relevant studies of the Area 3 RWMS have been conducted in the intervening years.

1.1 Site Description and History

The Area 3 RWMS is located in Yucca Flat at the NTS in Nye County, Nevada (Figure 1). The topography of the region is distinguished by north-south trending mountain ranges separated by alluvial valleys. The geology of Yucca Flat in the vicinity of the RWMS is characterized by thick sections of Paleozoic sedimentary rocks overlain by Tertiary volcanic rocks and deposits of alluvium consisting of post-volcanic sands and gravels (DOE, 1996a). At the Area 3 RWMS, the alluvium is more than 305 meters (m) (1,000 feet [ft]) thick, and the depth to groundwater is approximately 488 m (1,600 ft). Precipitation at this site averages 159 millimeters per year (6.3 inches per year) and average monthly temperatures range from 2º Celsius (36º Fahrenheit) in January to 25º Celsius (77º Fahrenheit) in July (Special Operations and Research Division Web site).

Figure 2 shows the location of U-3bl, one of seven subsidence craters within the boundaries of the Area 3 RWMS. These craters were formed by underground nuclear tests in the early 1960s, which were conducted hundreds of meters below the ground surface in shafts bored vertically

into the alluvium. Upon detonation of the nuclear device, the extreme pressure and temperature generated formed a cavity in the alluvium. When the gas pressure dissipated to a point at which it could no longer support the overburden, the roof of the cavity collapsed and the void region propagated upward to the surface, forming a saucer-like subsidence crater (U.S. Congress, 1989). The region through which the void propagated is referred to as the "collapse zone" or "chimney." At the time of their formation, the seven craters within the Area 3 RWMS ranged from 121.9 to 176.8 m (400 to 580 ft) in diameter, and from 14.0 to 32.0 m (46 to 105 ft) in depth (Plannerer, 1996).

Five of the craters (U-3ah, U-at, U-3ax, U-3bh, and U-3bl) have been used for disposal of low-level bulk radioactive waste. A waste cell called U-3ax/bl was formed from the U-3ax and U-3bl subsidence craters by excavating soil between the two craters (as shown in Figure 2) to form a single cell with a capacity of approximately 227,815 cubic meters (m^3) (8,050,000 cubic feet [ft^3]). Prior to excavation, U-3ax was 18.9 m (62 ft) deep and 138.1 m (453 ft) in diameter, and U-3bl was 14.0 m (46 ft) deep and 121.9 m (400 ft) in diameter. Disposal in U-3ax, the deeper crater, began in the late 1960s. Disposal in U-3bl began in 1984, when the level in U-3ax reached the bottom elevation of U-3bl. Waste forms consisted primarily of contaminated soil and scrap metal, with some construction debris, equipment, and containerized waste. The only liquid waste placed in U-3ax or U-3bl consisted of a small quantity of petroleum products remaining in machinery and tanks. The radioactive constituents were estimated to be approximately 1,200 curies, with 85 percent of the activity being due to tritium. The next largest single contributor was cobalt-60, which accounted for 1.6 percent of the total curie content. Most of the radioactive constituents were disposed during the years 1976 to 1981. The only known hazardous constituents were lead and cadmium. Disposal practices and waste inventory for U3-ax/bl have been documented by Elletson and Johnejack (1995).

A temporary cover of native alluvium was placed over the waste in December 1987. The cover ranges in thickness from less than 0.9 m (3 ft) to as much as 3.7 m (12 ft). In 2000, the U-3ax/bl waste disposal unit was closed under Interim Resource Conservation and Recovery Act status, as described in the closure plan (DOE, 2000a) and the closure report (DOE, 2001).

1.2 Context, Purpose, and Scope

Section 2.0 of this data report summarizes information regarding the 1962 nuclear test code-named BOBAC, that led to the formation of crater U-3bl. Section 3.0 describes the sampling methods and results from characterization borehole U-3bl-D2 (drilled in 1996), including field

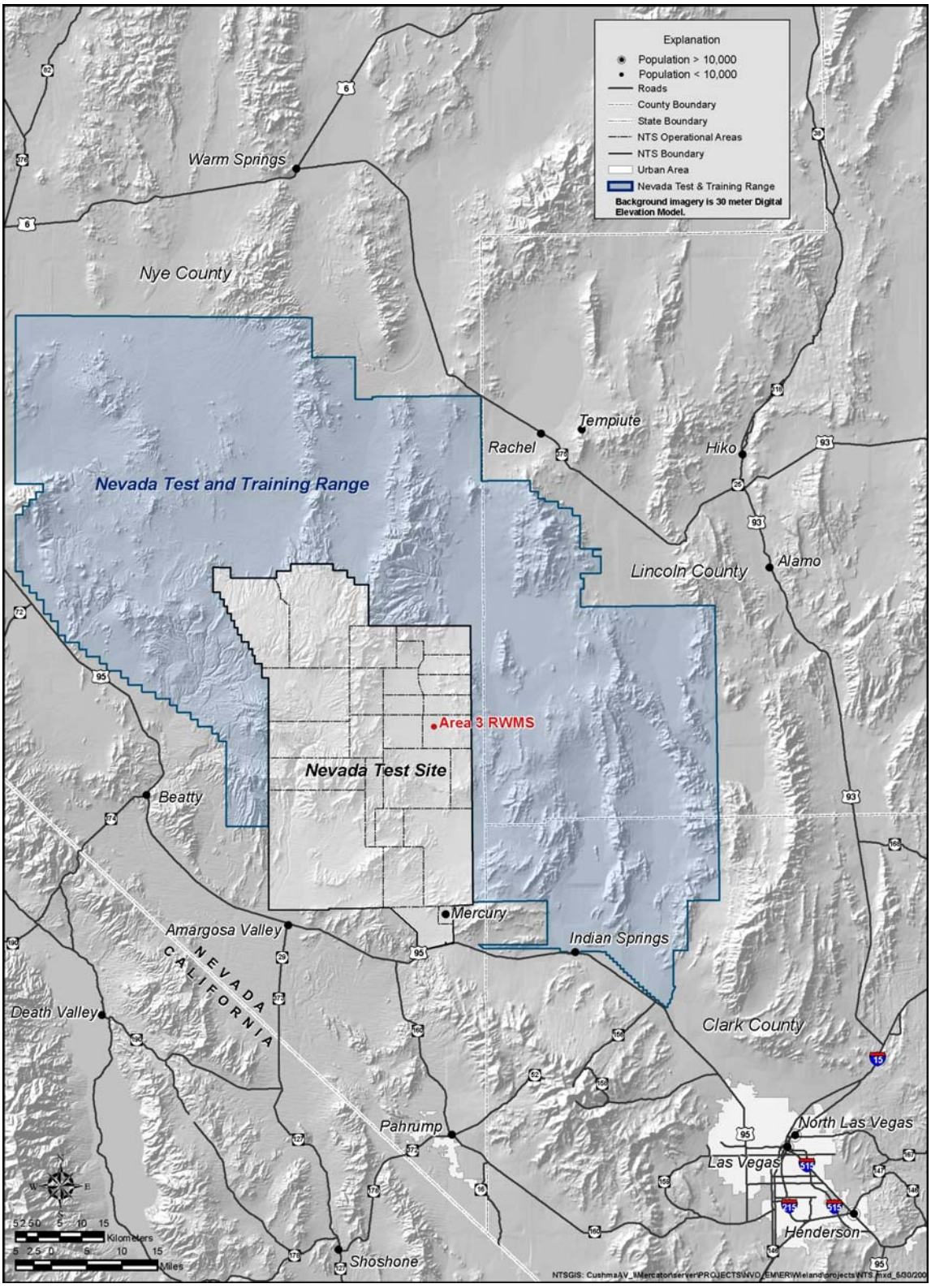

Figure 1
Location of Area 3 Radioactive Waste Management Site

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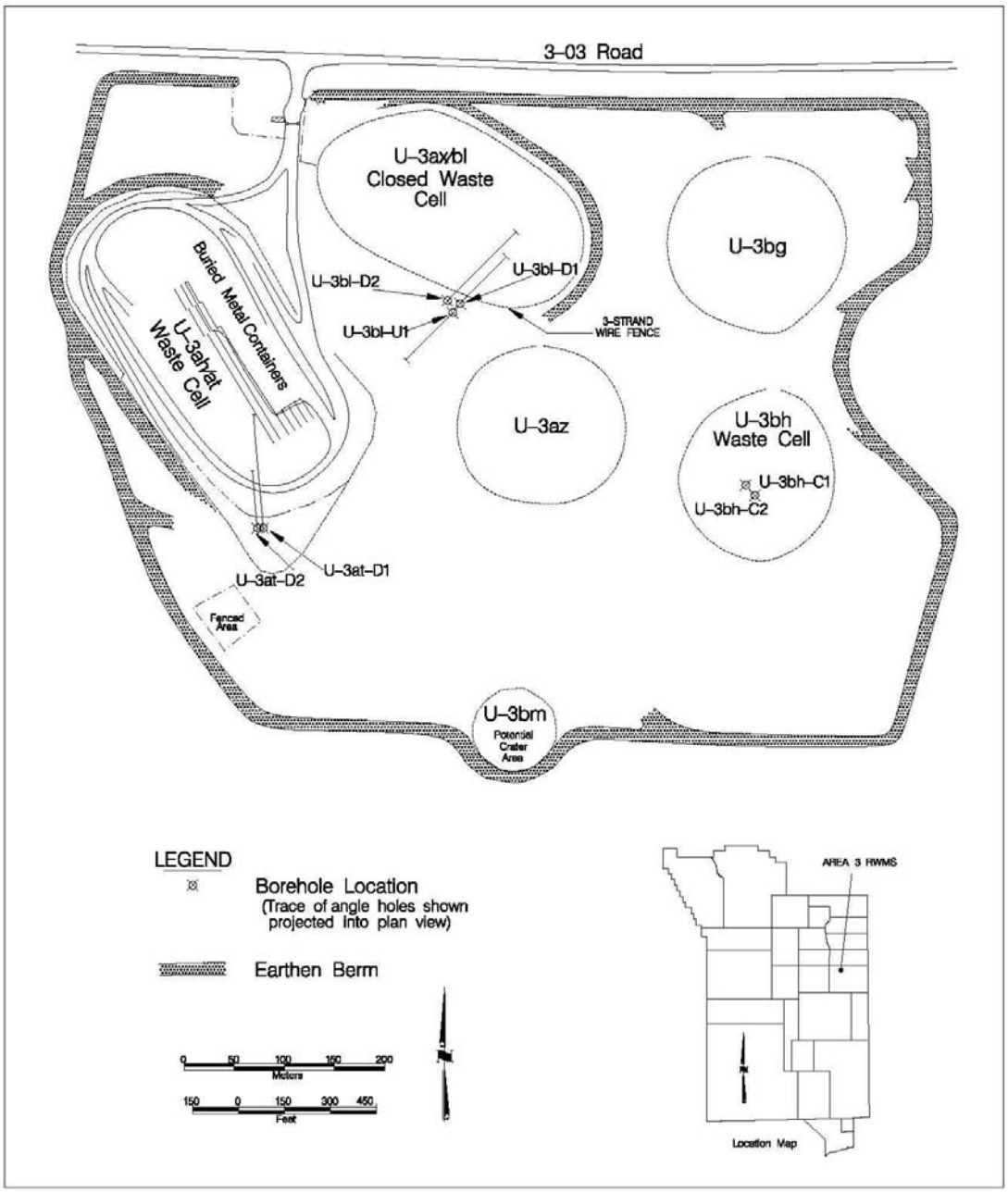

Figure 2
Area 3 Radioactive Waste Management Site Showing Locations of Characterization Boreholes

descriptions and laboratory analyses of 29 cores. The main objective of the review of the nuclear test records was to find site-specific characterization information that could be used to develop a conceptual model of the vadose zone for closure planning for the U-3ax/bl waste disposal unit. A sub-objective was to attempt to identify any potential preferential transport pathways related to the nuclear test that may affect closure.

The U-3bl collapse zone investigation was part of a broader characterization study of the upper alluvium of the Area 3 RWMS, conducted primarily to provide data for the Performance Assessment (PA) and Composite Analysis (CA) of the Area 3 RWMS. A PA is required by DOE Order 435.1, *Radioactive Waste Management* (DOE, 1999), for radioactive wastes disposed of on or after September 26, 1988 (DOE Order 435.1 superseded DOE Order 5820.2A ([1988]). The requirement for a CA for disposal sites is established in *Guidance for Composite Analysis of the Impact of Interacting Source Terms of the Radiological Protection of the Public from Department of Energy Low-Level Waste Disposal Facilities* (DOE, 1996b). Both analyses require site characterization information to formulate a conceptual model of the transport processes occurring in the system and to provide estimates of the variables used to quantify these processes.

In the 1990s, a total of seven characterization borings were drilled at or near the three waste cells (Figure 2). Three data reports (BN, 1998; 2005a; 2005b) provide detailed information on six of the characterization boreholes, and the seventh is reported here. Three of the seven characterization boreholes were drilled in the vicinity of U-3bl to determine the physical and hydrological properties of the disturbed alluvium in the collapse zones below the craters. Two angle borings were drilled in 1994, one below the U3ax/bl waste disposal cell and one away from the U3bl crater in relatively undisturbed alluvium (BN, 2005a). In 1996, a second angle borehole, designated U-3bl-D2 (the subject of this data report) was drilled below the U-3ax/bl waste disposal cell to intercept the U-3bl collapse zone; that is, the disturbed alluvium between the crater (surface collapse sink) and the nuclear test chamber.

The physical and hydraulic property data from these studies were used to develop the conceptual hydrogeologic model for the Area 3 RWMS and for flow and transport simulations. The report on the Area 3 RWMS PA and CA (Shott et al., 2000) summarizes and interprets the complete characterization study data set from all seven borings.

2.0 REVIEW OF NUCLEAR TEST RECORDS

A review of available data pertinent to the BOBAC underground nuclear test was completed by W. L. Hawkins of Los Alamos National Laboratory (Hawkins, 1994). The Nevada Test Site Drilling and Mining Summary (Raytheon Services Nevada, 1991) was also consulted. Principal findings are summarized here, and the detailed review by Hawkins, including construction information for all boreholes associated with the BOBAC test, is reproduced in Attachment A.

Hawkins noted that the operations and hydrogeologic setting for the BOBAC test conducted in the U3bl emplacement hole were typical for the period and location of testing. Construction of the emplacement hole began on June 2, 1962, with the drilling of a small-diameter pilot hole. The pilot hole was opened to a diameter of 1.2 m (4 ft) to a depth of 210.3 m (690 ft) below ground surface (bgs), and cased to a depth of 208.8 m (685 ft) bgs.

Six additional boreholes were drilled at the BOBAC site: four instrument holes drilled prior to the test, and two "post-shot" holes. Three of the instrument holes were drilled to a depth of 219.5 m (720 ft) bgs, and cased from the surface to a depth of 146.3 m (480 ft) bgs. The fourth instrument hole was drilled to a depth of 234.7 m (770 ft) bgs, and also cased to a depth of 146.3 m (480 ft) bgs. Following the installation of instrumentation, these boreholes were backfilled with sand to approximately 38.1 m (125 ft) bgs and filled with cement to the ground surface. Following the test, two post-shot holes were drilled to depths of 234.1 and 237.1 m (768 and 773 ft) bgs, but were cased only to 11.6 m (38 ft) bgs. The post-shot boreholes were probably left unplugged with a welded cap, blind flange, or abandonment valve at the top of the surface casing. There are no records describing how the post-shot holes were abandoned; however, with decades of subsequent ground motion, it is most likely that these holes have collapsed below the casing.

The device was placed at a depth of 195.1 m (640 ft) bgs in the emplacement hole, and the hole was stemmed to the surface. The first interval of stemming material consisted of 16 m^3 (565 ft^3) of magnetite sand placed at the bottom for instrument shielding. The magnetite layer was followed by alternating layers of coarse and fine sand, with the layers of fine sand (1.8 m [6 ft] thick) placed every 30.5 m (100 ft). A gypsum cement plug was poured as a gas seal to complete the final 3.0 m (10 ft) of stemming.

The BOBAC device was detonated on August 24, 1962 (DOE, 2000b). Collapse of the cavity occurred 8.2 minutes later, forming a rubble chimney and a surface subsidence crater. No

additional subsidence has been reported. The crater had a radius of 61.0 m (200 ft) and an estimated volume of 140,594 m^3 (4,968,000 ft^3). There was no evidence of any release of radioactivity resulting from the test.

3.0 BOREHOLE U-3bl-D2

Borehole U-3-bl-2 was the third hole drilled at or near the U-3bl crater for characterization of the near-surface alluvium. See BN, 2005a, for information about the first two holes, UE-3bl-D1 and UE-3bl-U1.

3.1 Drilling, Sampling, and Analysis

Drilling of borehole U-3bl-D2 began on February 29, 1996, adjacent to the U-3bl crater produced by the BOBAC nuclear test. The borehole was drilled at an angle of approximately 45 degrees so that it would pass under the waste cell and into the collapse zone below the crater. The location of borehole U-3bl-D2 is shown in Figure 2, and coordinates, land surface elevation, and depth are provided in Table 1.

Table 1
Location and Depth of Characterization Borehole U-3bl-D2

Borehole	Total Vertical Depth meters (feet)	Land Surface Elevation Above Sea Level meters (feet)	Nevada State Central Zone Coordinates (NAD 27)	
			North meters (feet)	East meters (feet)
U-3bl-D2	96.6 (317)	1,223 (4,014)	254,871.21 (836,189.97)	209,528.20 (687,427.09)

NAD 27= North American Datum of 1927.

Surface casing was set at a 45-degree angle in a trench 2.1 m (7 ft) deep, located near the edge of the temporary cover over U-3bl. The surface casing served to reduce dust and help guide the drill casing. The borehole was drilled with an Ingersoll-Rand T-4 drill rig using a casing-advance under-reaming (CAU) system. The CAU system consisted of an air percussion hammer attached to a drill rod within a casing 16.8 centimeter (cm) (6.63 inch [in.]) in diameter. A drive shoe was attached to the bottom of the casing. The air-percussion hammer drilled a hole slightly larger than the casing and advanced the casing by impacting the shoe. As the casing was advanced, additional casing segments were added at the surface until a coring depth was reached. Drill cuttings were forced to the surface through the casing, using only air as the drilling fluid.

The major advantage of a CAU system is that the continuous placement of casing in the borehole during drilling prevents the borehole from collapsing. Therefore, CAU systems are well suited for use in unconsolidated alluvium, where borehole collapse is a constant risk.

Core samples were obtained at approximately 3.05-m (10-ft) intervals, in a 0.76-m- (2.5-ft-) long solid-tube core barrel with an outside diameter (OD) of 11.43 cm (4.5 in.). The core barrel was lined with ten clear polycarbonate liner segments 7.62 cm (3 in.) long with an OD of 8.89 cm (3.5 in.). The core barrel was driven into the bottom of the hole using the air percussion hammer. After the core barrel was retrieved, the liner segments were removed using a pneumatic core extruder. A geologist developed a geologic description of the core by examining the open ends of each liner segment. Geologic descriptions consisted of visual estimates of moisture content, particle size distribution, lithology, sorting, and grain shape; any anomalies were also noted. The liner segments were then capped, taped, labeled with sample identification numbers, and sealed in tubular plastic laminate for shipping to laboratories for analyses. Sampling in U-3bl-D2 began at a borehole length of 61.3 m (201 ft), which corresponds to a vertical depth of 42.1 m (138 ft) bgs. The location of the U-3bl-D2 borehole with respect to U-3bl crater and the collapse zone is shown in Figure 3. The shaded area denotes the zone sampled.

At a borehole length of 66.8 (219 ft), the drive shoe detached from the casing, which required the removal of both the drill and surface casings from the borehole for repairs. A new 6.1-m (20-ft) length of 27.31-cm (10.75-in.) casing was then installed at a 45-degree angle to serve as the surface casing. Drilling proceeded to a borehole length of 66.8 m (219 ft) using 21.9-cm- (8.63-in.-) diameter casing. Below this depth, 16.8-cm- (6.63-in.-) diameter casing was used, and drilling and sampling continued to a final borehole length of 145.4 m (477 ft). This length corresponds to a vertical depth of 95.7 m (314 ft) bgs. A final core run was made at this depth.

Drillers completed 29 core runs in the U-3bl-D2 borehole. Although core recovery was generally less than 100 percent, recovery was sufficient for all runs to meet the minimum sample requirements of the analytical laboratories. The method of analysis, source of the method, and the laboratory performing the analysis are shown in Table 2 for each of the characterized properties. Volumetric water content and bulk density were measured on two cores from each core run to provide better knowledge of the variation of these properties with depth. BN audited and approved the quality assurance programs for Huffman Laboratories and Northwest Environmental Services, Testing, and Training.

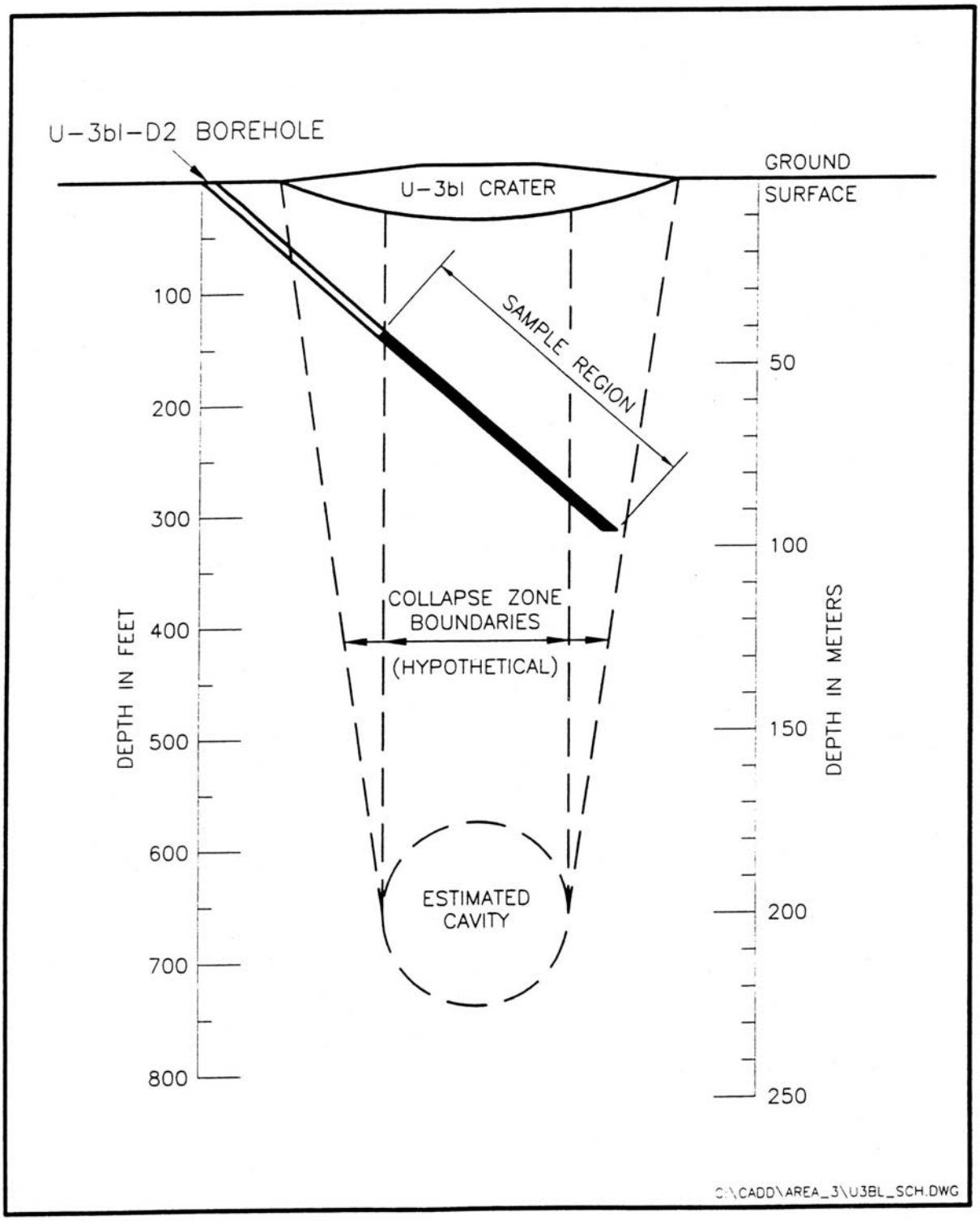

Figure 3
Schematic Showing the Location of Borehole U-3bl-D2 with Respect to the U-3bl Crater, Hypothesized Margins of the Collapse Zone, and Estimated Test Cavity

Table 2
Methods of Analysis

Characteristic/Property	Method	Reference	Laboratory
Geologic Description	Visual Manual	ASTM[a] (1990)	BN[b]
Particle Density	Liquid Pycnometer	Snyder et al. (1996)	HL[c]
Particle Size	Sieve and Pipette	Snyder et al. (1996)	HL
Bulk Density	Core	Blake and Hartge (1986)	NESTT[d]/BN
Water Retention	Centrifugation	Hoffman (1963)	NESTT
Hydraulic Conductivity Saturated Unsaturated	 Constant Head Centrifugation	 ASTM (1974) Conca and Wright (1992)	NESTT
Water Content	Volumetric	Snyder et al. (1996)	NESTT/BN
Water Potential	Water Activity Meter	Snyder et al. (1996)	BN
Chloride	Ion Chromatography	Snyder et al. (1996)	HL
Carbonate	Pressure Calcimeter	Snyder et al. (1996)	HL
Stable Isotopes	Mass Spectrometer	Gonfiantini (1981)	DRI[e]
Tritium	Liquid Scintillation	Burg (1994)	DRI

a American Society for Testing and Materials
b Bechtel Nevada
c Huffman Laboratories Inc.
d Northwest Environmental Services, Testing and Training
e Desert Research Institute

3.2 Results

Geologic descriptions based on visual examination of the cores obtained from the U-3bl-D2 borehole were recorded on borehole log sheets, which are reproduced in Attachment B. No visual evidence of preferential pathways for water was observed in the cores. Data plots depicting characteristics and properties of the characterization samples determined by laboratory analyses are presented in Attachment C. These same results are provided in tabular form in Attachment D. All results are presented in terms of the vertical depth of the sample rather than borehole drilled length.

The variation of particle density with depth is shown in Figure C-1. Particle densities range from 2,210 to 2,460 kilograms per cubic meter (kg/m^3). Values show no trends with depth and are

slightly lower than particle densities previously observed for shallower sediments within the RWMS. Percentages of sand, silt, and clay for the fine-earth (less than 2 millimeters [mm]) fraction of the samples are shown in Figure C-2. Results from this borehole are similar to others from the RWMS, with particle size distribution being dominated by the 0.05- to 2.0-mm sand fraction. In general, the sand fraction ranges from approximately 61 to 95 percent, with an average of 81 percent. The silt and clay fractions are less than 30 and 10 percent, respectively. These fractions are typical of loamy sand to sandy loam soil texture. The sample with the largest combined fraction of silt and clay (39 percent) is at a depth of 63.4 m (208 ft). Dry bulk density, shown in Figure C-3, ranges from 1,230 to 1,830 kg/m^3, with no obvious trend with depth. These values are within the range of bulk densities commonly observed for undisturbed alluvium on the NTS.

Water retention relations for the characterization samples are shown in Figures C-4 through C-6. This characteristic, while variable, is relatively consistent for the cores tested and is typical of water retention relations for other soils of similar texture. The range of water retention relations is represented by the samples from the depths of 69.5 and 71.3 m (228 and 234 ft) bgs. The sample from 69.5 m (228 ft) had the lowest water content at the initial matric potential of -0.004 MegaPascals (MPa) (16 in. of water) and drained to the lowest water content when a small additional tension was applied. This behavior is typical of coarse-textured materials. This sample has one of the lowest percentages of clay (4.3 percent) and highest percentages of sand (91 percent). The sample from 71.3 m (234 ft) shows increased water-holding capacity at saturation, because it has one of the highest porosities of the cores sampled. This sample drained less with applied tension because it has the highest clay fraction (16.9 percent) and one of the lowest sand fractions (74 percent).

The relationships between hydraulic conductivity and water content are shown in Figures C-7 through C-9. These hydraulic conductivity-water content relations were measured directly on samples and are not dependent on fitting model parameters to the water retention relations. The results are typical of sandy soil, with hydraulic conductivity decreasing rapidly as the soil dries. While variable, these relations show no trend with depth. The variability of these results reflects the subtle yet distinct differences in hydraulic properties of the alluvium layers. Deviation from the average behavior was seen in the sample from the depth of 68.6 m (225 ft) bgs, which had the highest measured hydraulic conductivity over the entire range of water content. At saturation, this sample had a hydraulic conductivity at least two orders of magnitude greater than the majority of other samples.

The variation of volumetric water content with depth is shown in Figure C-10. Water content values range from 0.08 to 0.20 cubic meters per cubic meter, and tend to increase with depth. The water potential values of samples taken from the U-3bl-D2 borehole range from -1.9 MPa at 42.4 m (139 ft) to -0.41 MPa at 94.5 m (310 ft) depth bgs (Figure C-11). Although variable, water potential tends to increase with depth. A similar range and trend was reported for water potentials of cores obtained at similar depths in Frenchman Flat (Detty et al., 1993).

Variations in the stable isotopic composition of pore water with respect to meteoric water provide indications of past and current water fluxes in the vadose zone. Stable isotope concentrations are expressed as the difference between the measured ratio of heavier to lighter isotopes in the sample and the same ratio measured in the reference standard (typically standard mean ocean water [SMOW]) in parts per thousand (‰). The most abundant isotopic forms of the element are used. For hydrogen, the ratio measured is deuterium to protium, and for oxygen, oxygen-18 to oxygen-16. In standard delta notation, these ratios normalized to SMOW are referred to as δD and $\delta^{18}O$, respectively.

Concentrations of the stable isotopes of hydrogen and oxygen in the pore water of samples obtained from the U-3bl-D2 borehole are shown in Figures C-12 and C-13. Concentrations are reported in standard delta notation in reference to SMOW. Reproducibility of the values is ± 1 ‰. Uniformity of the isotopic compositions with depth indicates that the alluvium below 39.6 m (130 ft) depth is not influenced by evaporation occurring at shallower depths.

Stable isotope concentrations in pore water from characterization samples and precipitation are shown in Figure C-14. The local meteoric water line (LMWL) represents the ratio of stable isotopes in precipitation and was described by Tyler et al. (1996) for the NTS as:

$$\delta D = 6.26 \bullet \delta^{18}O - 15.3$$

These authors estimated weighted mean concentrations for winter precipitation to be -12.5‰ and -93‰ for $\delta^{18}O$ and δD, respectively. Winter concentrations represent precipitation under cooler temperatures. Comparing the winter mean concentrations for the NTS with concentrations of the profiles shown in Figures C-12 and C-13, shows the isotopic compositions of the pore water samples fall below the LMWL. These samples are more depleted than weighted mean values for

winter precipitation alone. These results indicate that the pore water found in the samples from the collapse zone below 39.6 m (130 ft) must have infiltrated under cooler, past climate conditions.

The soil chloride profile shown in Figure C-15 indicates negligible amounts of chloride present except in one sample. Because this single sample (taken from 84.7 m [247 ft] bgs), was reported to have a chloride concentration two orders of magnitude higher than the other samples, another sub-sample from this interval was extracted and analyzed. The results of the second analysis were within 8 percent of the original estimate, indicating that the observed elevated chloride concentration was not due to analytical error. An inspection of this core sample and adjacent samples using a binocular microscope and in hand sample, found no obvious lithologic, diagenetic, or pedogenic explanation for the differences in chloride concentration.

Calcium carbonate equivalent for the characterization boreholes is shown with depth in Figure C-16. These results show calcium carbonate equivalent concentrations at 42.4, 46.0, and 63.4 m (139, 151, and 208 ft) bgs to be greater than 11 percent, substantially greater than most other samples analyzed. An inspection of these and adjacent samples under a binocular microscope and in hand sample found no significant difference in lithology, but the matrix of the three samples in question was cemented by calcium carbonate and contained fragments of weathered caliche.

Tritium concentrations versus depth for the characterization samples are shown in Figure C-17. Concentrations ranged from 2.68×10^3 to 1.22×10^4 picoCuries per liter. The maximum concentration was found in the sample from 75.0 m (246 ft) bgs. Although not at a level to raise environmental concerns, these concentrations are two to three orders of magnitude greater than expected from atmospheric deposition of tritium. This tritium most likely originated as a product of the nuclear test.

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ATTACHMENT A

Data Report and Review:
U3ax/bl Characterization and Closure

W. L. Hawkins
Los Alamos National Laboratory
1994

Data Report and Review U3ax/bl Site Characterization and Closure

Ward L. Hawkins
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I. Purpose and Scope

The Los Alamos National Laboratory has been funded by the Special Projects Section, Environmental Restoration and Technology Development Department, REECO, to produce a data report in support of a site characterization and closure program for the U3ax/bl waste disposal unit (WDU). Included in the report is general information regarding field operations at the site of these underground nuclear detonation events, specific information on the U3ax/bl WDU, and data on the other event sites of the Area 3 Radioactive Waste Management Site (RWMS).

The task is a compilation of data through a search of the literature, archives, and databases for operational, geological, hydrological, borehole, and event information in the vicinity of U3ax/bl. Emphasis is on site-specific characterization information which will be submitted with the closure plan and used to develop a conceptual model of the vadose zone (U3ax/bl Waste Disposal Unit).

II. Background

Testing of nuclear explosives has played a vital role in support of the national policy of nuclear deterrence and has enabled the U. S. Department of Energy to meet its statutory responsibility. The Nevada Test Site (NTS) was established on December 18, 1950 by President Truman as a continental area for the testing of nuclear devices. The first underground test was conducted in 1957.

The Limited Test Ban Treaty (LTBT) ratified by the United States, Great Britain and the Soviet Union in 1963 prohibited testing except under the ground surface. Since 1976 the United States has adhered to the Threshold Test Ban Treaty (TTBT), which limits the yield of any nuclear weapons test to 150 kilotons. After a successful Joint Verification Experiment in 1988, the US and the USSR agreed to techniques for treaty verification and the TTBT was ratified by both sides in 1990.

When an underground nuclear explosion occurs, the shock wave dynamically vaporizes and melts the rock in the immediate vicinity of the detonation point. The

shock-induced outward motion and high internal cavity pressure (the cavity is filled with gas which is mostly steam) cause the cavity to expand until the pressure has decreased to the point that the rock can no longer be deformed. The material then rebounds to form a large compressive stress field around the cavity. After cavity growth ceases and internal pressure drops below the amount necessary to support the overburden, the rock above the cavity falls into the void forming a rubble chimney which, depending upon the yield and overburden characteristics, may extend to the surface forming a subsidence crater.

Prior to the commencement of underground testing in 1957, the importance of hydrogeologic characterization for safety and environmental protection was recognized (Eckel, 1968). An intensive regional geologic mapping effort took place over much of the NTS between 1960 and 1965. Most of this early work was accomplished by the U. S. Geological Survey (Byers et al, 1989). Prior to 1971, event specific characterization was usually for operational considerations and explosion diagnostics. Samples were limited to drill bit cuttings collected periodically during drilling operations and an occasional bottom hole core. These techniques resulted in only generally representative samples because of material mixing. Borehole geophysical measurements, if made, were usually only in the vicinity of the explosion point and, again, the objective was to obtain data for explosion evaluation not detailed geologic site characterization (Houser, 1968).

Site specific hydrogeologic characterization efforts began in earnest following the BANEBERRY underground nuclear explosion in December 1970. Approximately 3.5 minutes after detonation, a large amount of radioactive gas and debris began venting through a fissure in the ground and continued venting for about 2 hours. Studies conducted shortly after the event identified the existence of geologic conditions which resulted in this prompt dynamic release (Glenn, et al, 1983,Terhune, et al, 1977, and USGS, 1974,). This experience indicated the need for a better understanding of the hydrogeologic setting. Following BANEBERRY, the U. S. Department of Energy (then the Atomic Energy Commission) established the Containment Evaluation Panel (CEP)

to review all aspects of a proposed test to prevent releases of radioactivity to the atmosphere (USDOE, 1986).

Typically, results of detailed interdisciplinary hydrogeologic investigations for each test location are included in a Containment Prospectus which is thoroughly examined by the CEP (Howard, 1983). Surface data include regional and site specific geologic maps, geophysical surveys (gravity, magnetic and seismic), and fracture patterns produced by previous detonations. Subsurface data are obtained from geophysical logs, rock and fluid samples, and borehole photography. Most subsurface data are from the large diameter emplacement holes, but nearby small diameter (0.1 to 0.3 m) exploratory or satellite holes are sometimes available for characterization purposes. Stratigraphy, lithology, geologic structure, hydrology, geochemistry, petrography, and physical properties are integrated into a comprehensive interpretation which, when combined with experiment design data, provide a model that can be used to assure every potential release concern has been addressed and complete containment is expected.

III. General Operations

Emplacement hole construction data for the seven event sites in the Area 3 RWMS are summarized in Table 1. Each of the RWMS emplacement holes (large diameter holes constructed to accommodate the nuclear explosive, and associated hardware, instrumentation and cables) was drilled with direct circulation. Two of the seven holes (U3bg and U3bh) were drilled with air, the others were drilled with a low fluid loss mud. Appendix A is the hole histories for the seven RWMS emplacement holes. These emplacement holes were drilled in stages beginning with a smaller diameter bit and then opened up with a larger bit to the final diameter. All of the emplacement holes were completely cased. Following insertion of the device and diagnostic instrumentation hardware, and associated cables, the holes were backfilled to the surface by dumping various combinations of fine and coarse material into the hole from ground level.

Appendix B is a summary of all the holes drilled for each event of the Area 3 RWMS. Satellite holes (pre-event holes drilled for the installation instrumentation to measure effects of the explosion) were drilled at each of the event sites. These holes were drilled prior to the events with mud and/or air. Air drilling included some water and soap to improve the lifting capacity of the circulating fluid. Some of the satellite holes were cased. After the installation of the instruments and cables, the holes were backfilled to the surface, often cemented in the upper section.

Post-shot holes were drilled after each of the RWMS events (Appendix B). These holes were drilled to retrieve, as quickly as possible, a sample from the working point region for radiochemical analyses. The two post-shot holes at U3ah were completely cased, all the other post-shot holes had only a cemented in surface casing down to less than 30 m (100 ft). Only one post-shot hole in the Area 3 RWMS (U3ax PS 6) was started outside the crater and directionally drilled toward the sampling zone at the bottom of the cavity. The others were vertically drilled within the collapse crater. All of the post-shot holes were drilled with mud. Circulation to the surface was avoided to prevent contaminated drilling fluids from reaching the ground level. Occasionally the edge of the collapse chimney was thought to have been detected either by drilling rate changes or slippage of drill pipe into a void. These occurrences were rarely documented.

Vertically drilled post-shot holes (Figure 1) in the crater were probably not backfilled but were left with a welded cap, blind flange or slide (abandonment) valve installed on the top of the casing (Butler, 1984). A blind flange is a bolted-on cap. The abandonment valves are off-the-shelf slide valves widely used in the petroleum industry to provide a pressure-tight seal at the top of a well. Post-shot holes directionally drilled from outside the crater (U3ax PS 6) were generally plugged to the surface. Records of activities following the drilling and sampling phase are poor, if they exist at all. Drilling and sampling hardware may have been left in some of these holes without being reported.

Appendix C is a listing of the borehole geophysical measurements made in the RWMS emplacement holes. The majority of the logs were directional surveys to map the location of the hole. Some useful information may be obtained from these logs however, these logs are paper records and will have to be retrieved from archives. Core samples, primarily bottom hole cores, were retrieved from U3ax, U3az, U3ah, and U3at, and are stored at the USGS core library.

Table 2 is a summary of event information relevant to the RWMS. Two of the events (FISHER, U3ah, and ACUSHI, U3bg) resulted in very minor releases of radioactivity. The release at FISHER was contained within a sampling line and the release at ACUSHI was right at Surface Ground Zero suggesting flow up the cased hole, perhaps associated with the downhole cables. Crater dimensions and collapse times for these events are normal for events of this type.

IV. Area 3 RWMS Hydrogeologic Setting

The Area 3 RWMS is in a portion of Yucca Flat where there is limited information from the deeper Alluvium and Tertiary volcanic rocks. The most complete (although almost 30 year old) hydrogeological data in the area is from U3cn the BILBY site some 1570 m (5150 ft) to the north (Garber and Johnston, 1967). In the vicinity of U3cn the alluvium is about 200 m (700 ft) to 290 m (950 ft) thick and the base of the alluvium is several hundred meters above the water table and regional zone of saturation. The welded, partially welded, nonwelded, and bedded Teriary tuffs are more than 600 m (2,000 ft) thick. Zeolitization of the tuffs has occurred both above and below the water table, and this zone of alteration is a fractured confining unit that can be as much as 450 m (1,500 ft) thick. Groundwater movement through this unit is believed to occur chiefly through fractures, at least under natural hydraulic gradients. Because of the extremely high bulk capillarity, the interstices of this zone of zeolitization are nearly fully saturated even hundreds of meters above the water table (Hoover, 1968).

Several test holes have penetrated carbonate rocks of Paleozoic age below the major part of Yucca Flat. These carbonate rocks form an extensive and very

permeable aquifer. Water in this aquifer appears to be moving slowly to the south. The piezometric surface is approximately 725 m (2,380 ft) above mean sea level and slightly lower than the water table in the over lying zeolitized tuff.

V. U3ax and U3bl Emplacement Operations

Site U3ax was used on 7 May 1962 for the PACA experiment. Figure 2 is the drilling and surface construction plan for U3ax. The location, horizontal displacement and vertical deviation of all the holes drilled at the U3ax site are shown in Figure 3. Table 3 is drill hole information for the holes drilled for the PACA event. The post-shot holes were probably abandoned as stated above (no specific information could be found). This means there could be holes which were drilled in the crater after the event and were left with only a seal at the top of the surface casing. The satellite holes that were used for PACA (Figure 4) were planned to be backfilled with sand to ~30 m (100 ft) from the surface then cemented to the surface (no "as-built" information was found). Appendix D is the hole histories for the Satellite and Post-shot holes for PACA.

Following installation of the device and diagnostics rack into the PACA emplacement hole (which was consumed within the vaporizing/melting radius of the explosion) and the 23 downhole cables, the hole was backfilled. The first layer of backfill was 5 m^3 (175 ft^3) of dust-free sand, then the hole was filled with "Mill-Run" cement sand to 3 m (10 ft) from the surface. A gypsum cement ("Calseal") plug was poured as a gas seal in the the upper 3 m (10 ft) of stemming at the top of the hole. Specifications for the cement sand were 100% passing 0.01 m (3/8 inch) screen and less than 5% passing a #10 screen. The water contentis estimated as between 1% and 3%.

There was an interesting incident documented following the backfilling at U3ax emplacement hole (Engstrom, 1993, Personnel Communication):

> "...on the "Paca" event in U3-ax on May 7, 1962. Stemming of this hole was also completed late in the afternoon of May 6, and as the crews were cleaning up at GZ, there was a decided rumble which sounded like a muffled explosion far underground. This started the

> Yucca Flats Track Meet as everyone around the hole took off at a dead run in different directions. Upon their sheepish return, the stemming was found to have slumped some 20-feet."

Site U3bl was used on 24 August 1962 for the BOBAC experiment. Figure 5 is the surface construction plan for U3bl. The location, horizontal displacement and vertical deviation of the holes used at the U3bl site are shown in Figure 6. Table 4 is drill hole information for the holes drilled for the BOBAC event. The post-shot holes were probably abandoned as stated above (no specific information could be found). The satellite holes that were used for BOBAC (Figure 7) were planned to be backfilled with sand to ~38 m (125 ft) from the surface then cemented to the surface with concrete (no "as-built" information was found). Appendix E is the hole histories for the Satellite and Post-shot holes for BOBAC.

Following installation of the device and diagnostics rack into the BOBAC emplacement hole (which was consumed within the vaporizing/melting radius for the explosion), along with the 38 downhole cables, the hole was backfilled. After the first layer (16 m^3 of magnetite sand for instrument sheilding) was installed, the hole was filled with sand. Two-meter (6 ft) thick fines layers were placed every 30 m (100 ft) above the magnetite. A gypsum cement ("Calseal") plug was poured as a gas seal the upper 3 m (10 ft) of stemming. Specifications for the sand were 100% passing 0.01 m (3/8 inch) screen and less than 5% passing a #10 screen. Fines material had to all pass a #3 screen. The water contentis estimated between 1% and 2%.

There were several recorded instances of bridging, and post-backfilling slumping of the backfill material upon collapse of the bridge. Slumping of the backfill at PACA was believed to have been the result of rapidily filling the hole from the surface which resulted in the bridging. During the 15 months following PACA the backfilling procedure evolved, primarily through trail and error, to a prescribed rate of filling which was prevented bridging. The use of alternating layers of fine and coarse grained material at BOBAC was part of this evolutionary process.

VI. U3ax/bl Event Information

Table 2 includes event information for the PACA and BOBAC events. Figure 8 is contour maps of the craters. None of the phenomena associated with these detonations suggests anything unusual about the sites. There was no release of radioactivity to the surface. They both had cavity collapase and surface crater formation at typical times. Events conducted during this period of time did not use current containment practices of cable gas blocking and installation of impermeable plugs; however, the use of alternating coarse and fines layers at BOBAC is similar to modern practices.

VII. U3ax/bl Hydrogeologic Information

As for the entire RWMS, the hydrological and geological information is very limited for U3ax/bl. Table 5 is the lithologic log produced by the US Geological Survey for U3ax (Cole and Williams, 1962). Table 6 is a listing of the borehole measurements and geophysical logs from the two sites. These data are not in digital form and are stored in DOE archives. There are cuttings samples available from both holes and bottom hole core from U3ax. Aerial photos were taken before and after each event.

Appendix F is a detailed geological site characterization prepared in 1983 for a containment prospectus for emplacement site U3lb, which is some 870 m (2855 ft) to the north-northeast of the U3ax/bl WDU. This emplacement hole is in unsaturated tuffaceous alluvium. The hole construction history does not indicate any geologic pecularities encountered during drilling operations for this 1.32 m (52 in) diameter, 243.8 m (800 ft) deep hole.

Surface features of interest in the area of U3lb are shot-related radial and concentric fractures and the Area 3 fault. U3lb did not penetrate the tuffs so the stratigraphy below the alluvium is projected from nearby holes, primarily U3kx which is in a very similar structural setting. Figure 9 is an alluvium isopach map produced by the LANL Geologic Support Group of RSN (Raytheon Services of Nevada) (Drellack,1988, Personal Communication), it shows the lack of information regarding

the thickness of the alluvium in the region of the Area 3 RWMS. The Paleozoic surface is estimated to be at a depth of 1040 m (3410 ft) and the alluvium/tuff contact is predicted to be at a depth of 275 m (900 ft). Depth to the water table is approximately 490 m (1600 ft). The major structural feature is the Area 3 fault mm (ft) to the east, but there is no surficial evidence of this fault near U3lb.

The U3lb caliper log shows a very smooth hole for alluvium. No zones of low resistivity that might suggest clay layers were noted on the electric log. Density log data indicates an average bulk density of 1.64 Mg/m^3 for the entire empalcement hole. The material properties for the medium at U3lb are normal for unsaturated Area 3 alluvium. Depth to the water table was estimated to be 500 m (1640 ft) .

VIII. Time Domain Reflectometry Measurements

Time Domain Reflectometry (TDR) is a technique that has been used to determine the length of unbroken cable. An electrical pulse is sent along the cable. Where the cable is damaged, the pulse reflects back to the source. Through calculations using the measured round-trip travel time for the pulse and the known conductance characteristics of the cable a length can be determined.

TDR data have been used to estimate the length of downhole cables following an underground test in an attempt to learn something about cavity collapse height and position of backfill material in the emplacement hole. In some cases this information has been useful in a supportive role when combined with other information such as predicted collapse phenomena and known condition of downhole instrumentation. In most cases, the information has been ambiguous, and inconsistent with other more reliable data. For example, TDR has shown cables damaged well above the upper limit of a subsurface collapse while other cables are undamaged well into the collapse rubble. It would be difficult to defend any interpretation of chimney and collapse features with only this data.

IX. Summary

An examination of the data included in this report suggests that the operations and hydrogeologic setting for the U3ax/bl Waste Disposal Unit are typical for an event conducted in this time frame and in this part of Yucca Flat. The events were not unusual either in the downhole hardware or the method of emplacement. All of the holes within the average crater radius were stemmed such as satellite holes. Post-shot holes were almost entirely uncased and were probably left unplugged but with some form of closure at the top of the short surface casing.

Acknowledgments

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Hole	Northing (ft)	Easting (ft)	Drilled Depth (m)	Hole Diamater (m)	Casing Depth (m)	Casing Inner Dia. (m)
U3ah	836287	686481	370.3	0.66	368.2	0.61
U3at	835799	686829	309.4	1.07	306.3	0.74
U3ax	836550	687258	267.3	1.07	265.1	0.74
U3az	835803	687693	268.8	1.07	265.1	0.74
U3bg	836400	688400	329.2	1.07	265.4	0.74
U3bh	835600	688401	329.2	1.07	265.1	0.74
U3bl	836399	687600	211.2	1.22	208.7	0.91

Table 1. Hole construction information for the seven event emplacement holes in the Area 3 RWMS. After insertion of the device and the diagnostics hardware the holes were backfilled to the surface. (U3bg and U3bh were drilled to 329.2 m with a 0.66 m diameter bit but they were only opened up to install casing to just below the casing depth.)

Hole	Event	Date	DOB (m)	Collapse Time (min)	Crater Radius (m)	Crater Diameter (m)	Crater Volume (m^3)
U3ah	FISHER	12/3/61	363	27.5	89	178	
U3at	JERBOA	3/1/63	301	35.3	85	168.9	246187
U3ax	PACA	5/7/62	258	15.6	70	138.4	88153
U3az	DORMOUSE PRIME	4/5/62	260	8.6	80	158.5	230896
U3bg	ACUSHI	2/8/63	260	21.6	79	156.7	182729
U3bh	HYRAX	9/14/62	216	7.9	78	155.4	168967
U3bl	BOBAC	8/24/62	195	8.2	61	121.9	140678

Table 2. Event surface collapse data and crater dimensions. FISHER and ACUSHI seeped small amounts of radiation to the ground surface at the test location.

Hole	Separation (m)	Bearing	Hole Type	Elevation (m)	Drilled Depth (m)	Hole Diameter (m)	Casing Depth (m)	Casing Inner Dia. (m)
U3ax			Emplacement	1226	267.3	1.07	265.1	0.737
U3ax-1	5	N4W	Satellite	1226	278.9	0.244	247.8	0.273
U3ax-PS-1	5	S27W	Post-shot	1213	297.2	0.244	12.2	0.273
U3ax-PS-1S	6	S6E	Post-shot	1213	288.0	0.244	12.2	0.273
U3ax-ps-2	6	N25E	Post-shot	1212	297.2	0.244	12.2	0.273
U3ax-2	8	N2W	Satellite	1226	278.9	0.244	248.1	0.273
U3ax-3	12	N2W	Satellite	1226	278.9	0.244	243.5	0.273
U3ax-4	15	S60E	Satellite	1226	10.4	0.737	10.4	0.737
U3ax-PS-6	96	N75E	Post-shot	1226	331.0	0.159	12.2	0.178
U3AX-PPS-5	96	Due E	PrePost-shot	1226	12.2	0.273	12.2	0.273
U3ax-PPS-4	96	Due S	PrePost-shot	1225	12.2	0.273	12.2	0.273
U3ax-PPS-3	96	S80W	PrePost-shot	1225	12.2	0.273	12.2	0.273

Table 3. Summary of hole construction data for all the holes drilled for the U3ax (PACA) event. The satellite holes were drilled prior to the event for installation of instrumentation and backfilled with sand to approximately 30 m (100 ft) from the surface and cemented from there to the surface. Post-shot holes were drilled to obtain samples for radiochemical analyses. There are no records of how the vertically-drilled post-shot holes were abandoned, but it was common practice to just install a welded cap, blind flange or slide valve on the top of the surface casing and not backfill these holes drilled within the surface collapse crater holes. PrePost-shot holes were started with a surface casing but not used.

Hole	Separation (m)	Bearing	Hole Type	Elevation (m)	Drilled Depth (m)	Hole Diameter (m)	Casing Depth (m)	Casing Inner Dia. (m)
U3bl	0		Emplacement	1226	211.2	1.016	208.7	0.91
U3bl-PS-1	5	N65W	Post-shot	1216	234.1	0.244	11.6	0.273
U3bl-PS-2	5	N65E	Post-shot	1216	236.6	0.244	11.6	0.273
U3bl-1	8	N2E	Satellite	1226	260.9	0.244	146.3	0.273
U3bl-2	11	N2W	Satellite	1226	260.6	0.244	146.3	0.273
U3bl-3	16	Due N	Satellite	1226	260.0	0.244	146.3	0.273
U3bl-3s	17	N85E	Satellite	1226	234.7	0.244	146.3	0.273
U3ax-PPS-5	47	N11W	PrePost-shot	1226	12.2	0.273	12.2	0.273

Table 4. Summary of hole construction data for all the holes drilled for the U3bl (BOBAC) event. The satellite holes were drilled prior to the event for installation of instrumentation and backfilled with sand to approximately 38 m (125 ft) from the surface and cemented from there to the surface. Post-shot holes were drilled to obtain samples for radiochemical analyses. There are no records of how the vertically-drilled post-shot holes were abandoned, but it was common practice to just install a welded cap, blind flange or slide valve on the top of the surface casing and not backfill these holes drilled within the surface collapse crater holes. PrePost-shot holes were started with a surface casing but were not used.

Table 5

U3ax LITHOLOGIC LOG
(Cole and Williams,1962)

Description	Depth Interval (m)
Tuffaceous sand. Tuff fragments, purple welded (30 %). White zeolitized and partly welded (50 %). Pink and pale green (5 %). Quartz and feldspar crystals (5 %). Lithic and rock fragments (10 %). Coarse to fine sands sizes, angular to rounded	3.1-36.6
No samples collected	36.6-103.6
Tuffaceous sand and gravel. Tuff fragments, purple welded (35 %), white, zeolitized and welded (35 %), pink and other types (<5 %). Quartz and feldspar crystals (<5 %). Rock fragments, mostly basalt and quartzite (20 %). Gravel to medium sand size, much coarser than 3.1 to 36.5 m interval, angular to rounded	103.6-120.4
Tuffaceous sand. Tuff fragments, purple welded (25 %), white and light-colored zeolitized and welded (40 %), brown fine-grained tuff (10 %), others (3 %). Quartz and feldspar (2 %). Rock fragments (20 %). Coarse sand size, angular to rounded. End of cuttings.	120.4-137.2
No samples collected.	137.2-260.6
Tuffaceous sand and gravel. Tuff fragments, pale yellow and white, zeolitized (55 %). Quartz and feldspar grains (40 %). Lithics, quartzite and argillite (5 %). Mafic minerals, mainly magnetite (1 %). Grain sizes range from silt to pebble size, but the average is medium sand. Particles are angular to rounded. The material is uncemented and the core crumbles easily when handled. Core samples.	260.6-263.7

Average Physical Properties for U3ax	
Dry bulk density	1.43 g/cc.
Grain density or matrix density	2.45 g/cc.
Sample state bulk density	1.77 g/cc.
Saturation	83 volume %
Porosity	42 volume %
Water content	20 weight %
Magnetic susceptibility	352 x 10^{-6} cgs units.

Hole	LOGS
U3bl	DIR GYRO
U3bl-PS-1	DIR MAG, 2 HIGH INTENSITY GAMMA, TEMP
U3bl-PS-2	DIR MAG, HIGH INTENSITY GAMMA, TEMP
U3bl-1	DIR GYRO
U3bl-2	DIR GYRO
U3bl-3	NO LOGS
U3bl-3s	DIR MAG

U3ax	CVL, DIR GYRO, ELOG, ELOG FOCUS, ELOG IND, GR-N, TEMP
U3ax-1	CALIPER, DIR GYRO
U3ax-ps-1	DIR MAG, GAMMA
U3ax-ps-1s	DIR MAG, GAMMA
U3ax-ps-2	DIR MAG, GAMMA
U3ax-2	CALIPER, DIR GYRO
U3ax-3	CALIPER, DIR GYRO
U3ax-4	NO LOGS
U3ax-ps-6	DIR MAG, GR-N, TEMP
U3ax-pps-5	NO LOGS
U3ax-pps-4	NO LOGS
U3ax-pps-3	NO LOGS

Table 6. Borehole measurments in all holes for the U3ax and U3bl events. (See Table 7 for explaination.)

DIR GYRO = Directional Gyroscope This log is used in a directional survey of a borehole to acquire measurements of drift, azimuth, and inclination of a borehole with the vertical. Essentially maps the subsurface location of a borehole.
DIR MAG = Directional Magnetic Compass This log is used in a directional survey of a borehole. Essentially maps the subsurface location of a borehole.
HIGH INTENSITY GAMMA = Special gamma logging tool used in post shot holes. Measures high intensity gamma rays from nuclear explosions.
TEMP = Temperature logging tool measures the bore hole temperature.
CVL = Continuous Velocity Log. This log is an acoustic tool that measures the formation compressional velocity. This information can be used to estimate the porosity, rock strength, and travel speed in the formation or rocks surrounding the borehole.
ELOG = Electric Log. This log is a galvanic resistivitv tool that measures the short normal, the long normal, and the lateral re6istivity of the formation surrounding the borehole. This resistivity information can be used to estimate the porosity and saturation of the formation. It also can be used to locate clay.
ELOG FOCUS = Focussed Electric Log. This log is a galvanic guard electric logging tool that focuses current into the formation. This resistivity information can be used like the ELOG resistivity information.
ELOG IND = Induction Electric Log. This log is an electromaqnetic resistivity tool. It induces current into the formation and measures the forniation resistivity. This resistivity can be used like the ELOG resistivity information.
GR-N = Gamma Ray Neutron Porosity. This probe is a stacked nuclear tool (it is two logging tools in one probe) that measures the natural gamma radiation from the rocks surrounding the borehole and also measures the neutron response to hydrogen from formation water. The information from the gamma radiation can be used for correlation from hole to hole and to locate clay. The information from the neutron measurement can be used to estimate the water content and the porosity of the formation.

Table 7. Explaination of geophysical logging measurements made in the U3ax/bl Waste Dispsal Unit drill holes (Table 6).

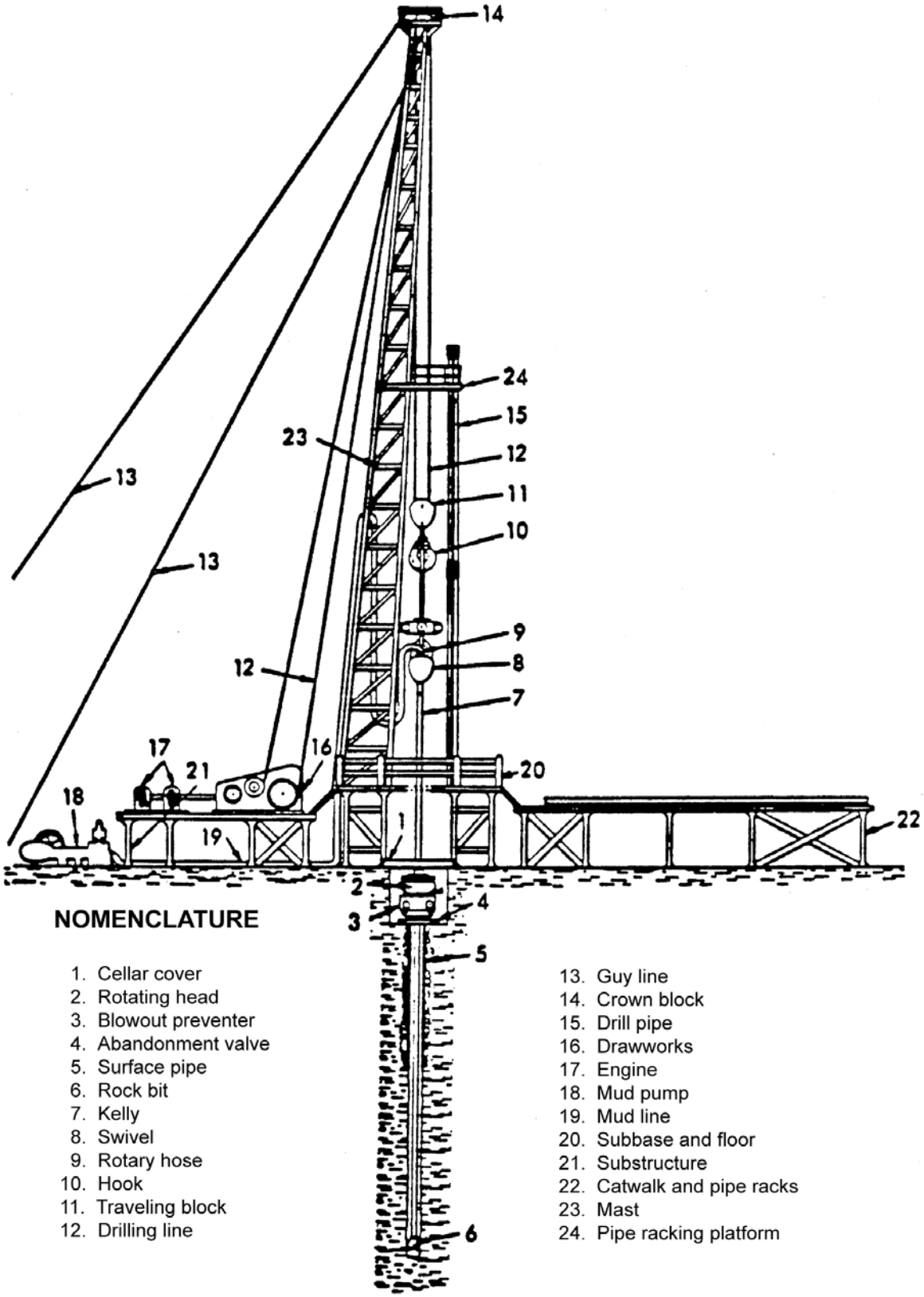
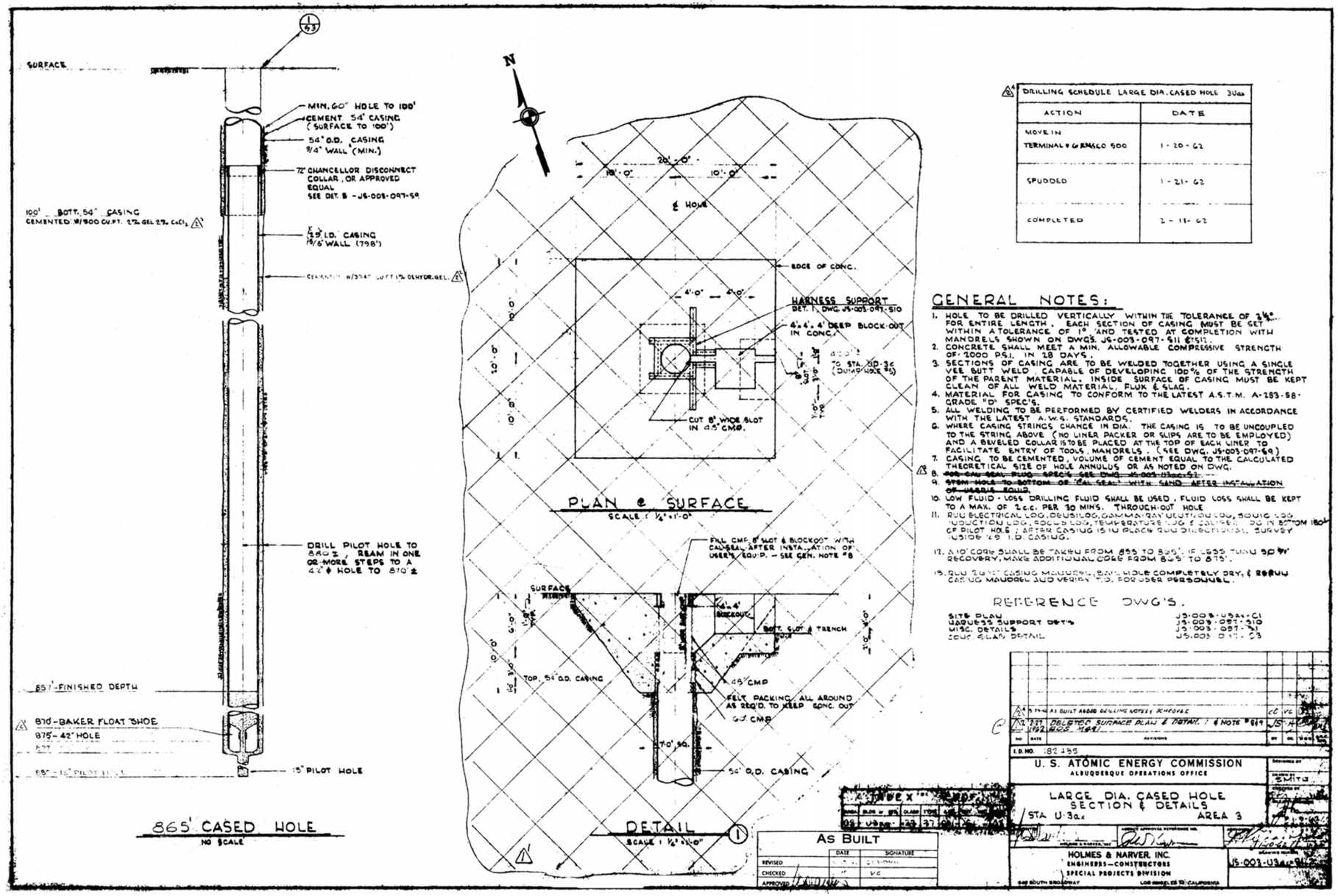


Figure 1. Standard Vertical Post-shot Drill Rig and Equipment (Butler, 1984)



DRILLING SCHEDULE LARGE DIA. CASED HOLE 3Uax	
ACTION	DATE
MOVE IN TERMINAL & GRAVEL SUB	1-20-62
SPUDDED	1-21-62
COMPLETED	2-11-62

GENERAL NOTES:

1. HOLE TO BE DRILLED VERTICALLY WITHIN THE TOLERANCE OF 2½°.. FOR ENTIRE LENGTH. EACH SECTION OF CASING MUST BE SET WITHIN A TOLERANCE OF 1° AND TESTED AT COMPLETION WITH MANDRELS SHOWN ON DWGS. JS-003-097-S11 & S15.
2. CONCRETE SHALL MEET A MIN. ALLOWABLE COMPRESSIVE STRENGTH OF 2000 P.S.I. IN 28 DAYS.
3. SECTIONS OF CASING ARE TO BE WELDED TOGETHER USING A SINGLE VEE BUTT WELD, CAPABLE OF DEVELOPING 100% OF THE STRENGTH OF THE PARENT MATERIAL. INSIDE SURFACE OF CASING MUST BE KEPT CLEAN OF ALL WELD MATERIAL, FLUX & SLAG.
4. MATERIAL FOR CASING TO CONFORM TO THE LATEST A.S.T.M. A-283-58-GRADE "D" SPEC'S.
5. ALL WELDING TO BE PERFORMED BY CERTIFIED WELDERS IN ACCORDANCE WITH THE LATEST A.W.S. STANDARDS.
6. WHERE CASING STRINGS CHANGE IN DIA. THE CASING IS TO BE UNCOUPLED TO THE STRING ABOVE (NO LINER PACKER OR SLIPS ARE TO BE EMPLOYED) AND A BEVELED COLLAR IS TO BE PLACED AT THE TOP OF EACH LINER TO FACILITATE ENTRY OF TOOLS, MANDRELS. (SEE DWG. JS-003-097-S9)
7. CASING TO BE CEMENTED, VOLUME OF CEMENT EQUAL TO THE CALCULATED THEORETICAL SIZE OF HOLE ANNULUS OR AS NOTED ON DWG.
8. ~~FOR CAL SEAL PLUG SPEC'S SEE DWG. JS-003-097-S1.~~
9. ~~STEM HOLE TO BOTTOM OF CAL SEAL WITH SAND AFTER INSTALLATION OF USER'S EQUIP.~~
10. LOW FLUID - LOSS DRILLING FLUID SHALL BE USED, FLUID LOSS SHALL BE KEPT TO A MAX. OF 7 c.c. PER 30 MINS. THROUGH-OUT HOLE
11. RUN ELECTRICAL LOG, DENSILOG, GAMMA RAY LOG, NEUTRON LOG, SONIC LOG, INDUCTION LOG, FOCUS LOG, TEMPERATURE LOG & CALIPER LOG IN BOTTOM 180' OF PILOT HOLE; AFTER CASING IS IN PLACE RUN DIRECTIONAL SURVEY OUTSIDE 42" I.D. CASING.
12. A 10' CORE SHALL BE TAKEN FROM 855 TO 865'. IF LESS THAN 50% RECOVERY, MAKE ADDITIONAL CORE FROM 805' TO 815'.
13. RUN 26" CASING MANDREL, BAIL HOLE COMPLETELY DRY, & REMOVE CASING MANDREL AND VERIFY I.D. FOR USER PERSONNEL.

REFERENCE DWG'S.

SITE PLAN	JS-003-U3ax-C1
HARNESS SUPPORT DETS	JS-003-097-S10
MISC. DETAILS	JS-003-097-S1
SOUP SLAB DETAIL	JS-003-097-S3

NO.	DATE	REVISIONS	BY	CH.	APP'D
1	3/62	DELETED SURFACE PLAN & DETAIL 1 & NOTE #9	VC		

I.D. NO. 82435

U. S. ATOMIC ENERGY COMMISSION
ALBUQUERQUE OPERATIONS OFFICE

LARGE DIA. CASED HOLE SECTION & DETAILS
STA U-3ax AREA 3

HOLMES & NARVER, INC.
ENGINEERS—CONSTRUCTORS
SPECIAL PROJECTS DIVISION
340 SOUTH BROADWAY LOS ANGELES 13, CALIFORNIA

JS-003-U3ax-S1

AS BUILT

	DATE	SIGNATURE
REVISED		
CHECKED	"	VC
APPROVED		

Figure 2. Drilling and Surface Construction Plan for U-3ax
(Drawing # JS-003-U3ax-S1.2)

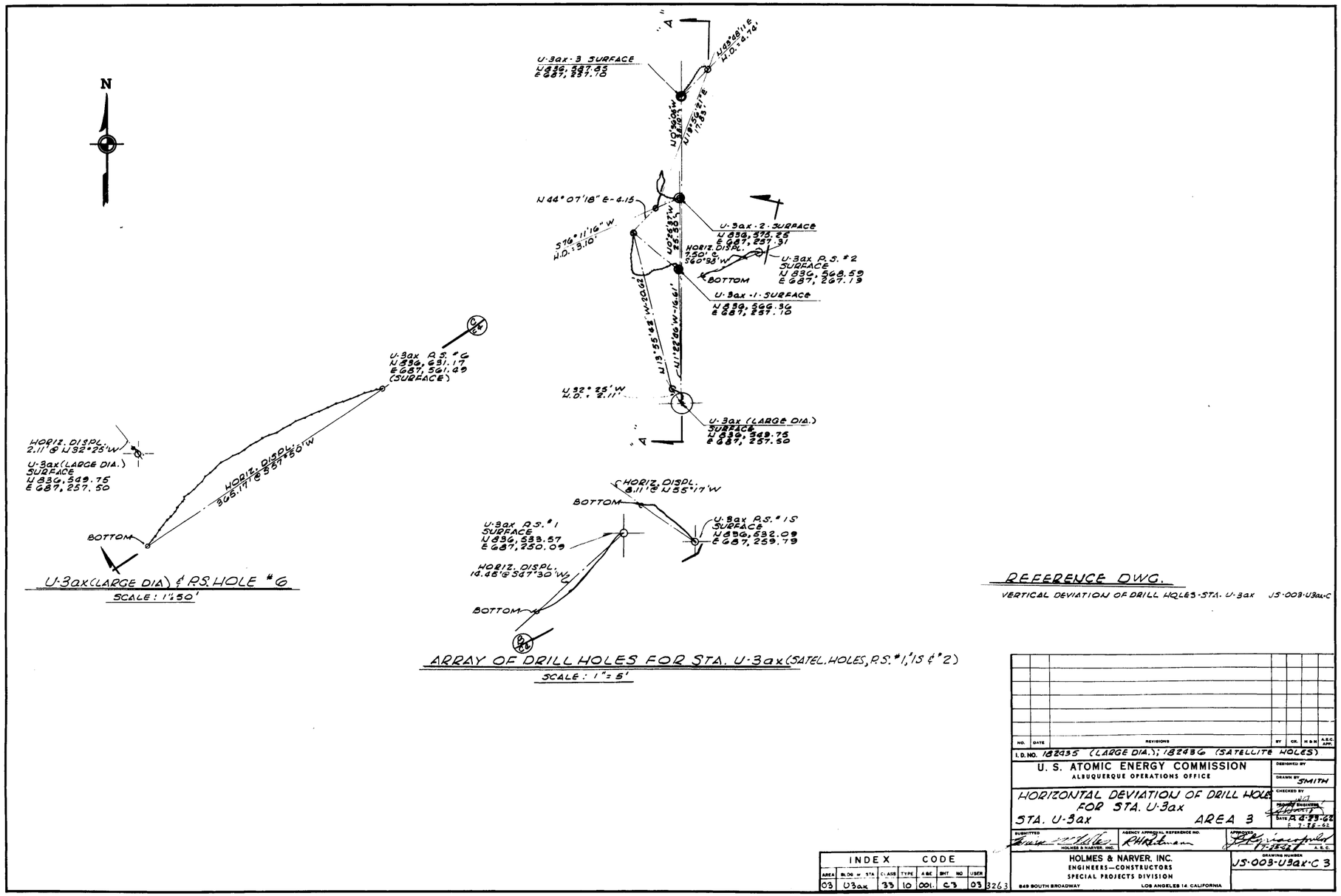
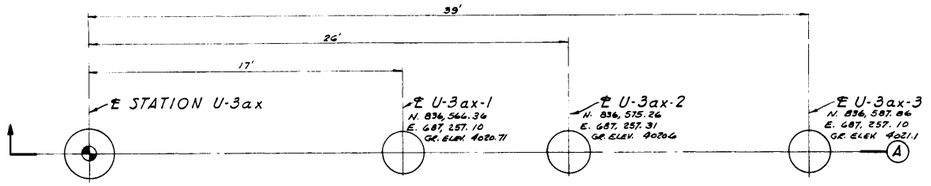
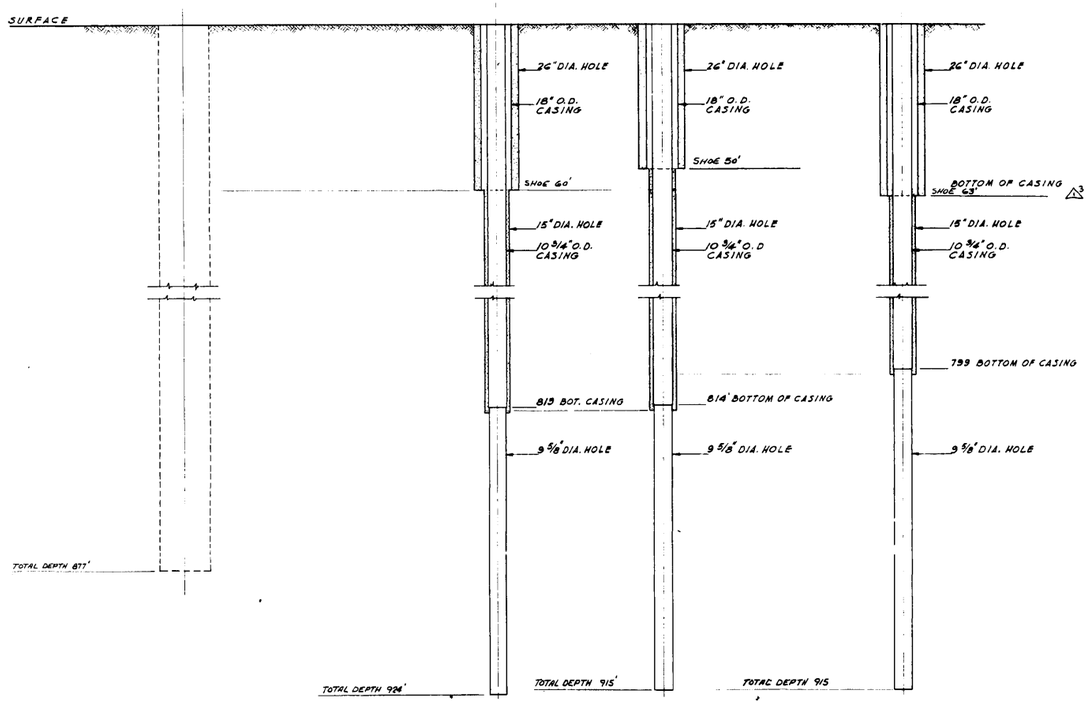


Figure 3. Surface and Subsurface Location of Holes for the Event at U3ax
(Drawing # JS-003-U3ax-C3)



PLAN



STATION U-3ax U-3ax-1 U-3ax-2 U-3ax-3

SECTION (A) △3

N

GENERAL NOTES

1. DRILLING MUD SHALL BE OIL EMULSION TYPE WITH A FLUID LOSS OF LESS THAN 2 cc/30 MIN. WEIGHT TO TO 72. MAX. SAND CONTENT, 3 % VISCOSITY - 50-60 SEC.
2. SET 18" CASING WITH APPROX. 100 CU. FT. COMMON CEMENT SLURRY MIX WITH 2 % GEL AND 2 % HA-5. WAIT ON CONCRETE 8 HOURS.
3. SET 10 3/4" CASING WITH APPROX. 1000 CU. FT. COMMON CEMENT SLURRY MIX WITH 2 % GEL AND 2 % Ca Cl 2.
4. RUN CALIPER LOG AT BOTTOM OF 15" HOLE PRIOR TO CASING.
5. AFTER CASING HOLE SUSPEND OPERATIONS AND MOVE RIG OFF AT USERS REQUEST MOVE ON AND CONTINUE DRILLING TO T.D. WITH AIR IF AVAILABLE.

△1

△2 7. RUN DIRECTIONAL SURVEY FROM SURFACE TO TOTAL DEPTH.

8. HOLES SHALL BE BAILED DRY PRIOR TO PLACING USERS INSTRUMENTS. HOLES ARE TO BE BACKFILLED WITH SAND TO 100' ABOVE INSTRUMENT STRING AND CEMENTED TO SURFACE ABOVE SAND.

REFERENCE DRAWINGS

SITE PLAN, STA. U-3ax.	JS-003-U-3ax-C1
STRUCTURAL DETAILS STA. U-3ax	JS-003-U-3ax-S1

AS-BUILT NOTE

THE GENERAL NOTES WERE FOLLOWED AS STATED.

INDEX CODE							
AREA	SE DG or STA	CLASS	TYPE	A.B.K.	SHT NO	USER
03	U3ax	33	37	001	52	05

AS-BUILT
HOLMES & NARVER, INC.
Engineers — Constructors
Date 2-20-1963 | By AT Fillios | CKD
Approved 2-25-63

△4 8-30-1963 AS-BUILT. REVISED PLAN & SECTION & GEN. NOTES. ATF

NO.	DATE	REVISIONS	BY	CK.	H & N	A.E.C. APP.

I. D. NO. 82436

U. S. ATOMIC ENERGY COMMISSION
ALBUQUERQUE OPERATIONS OFFICE

DESIGNED BY EDJ M-326
DRAWN BY ENGLEY
CHECKED BY PH
PROJ. ENGINEER
DATE 8-12-28-61
2-1-6-62

SANDIA DIAGNOSTIC TEST HOLES
PLAN AND SECTION
STA. U-3ax AREA 3

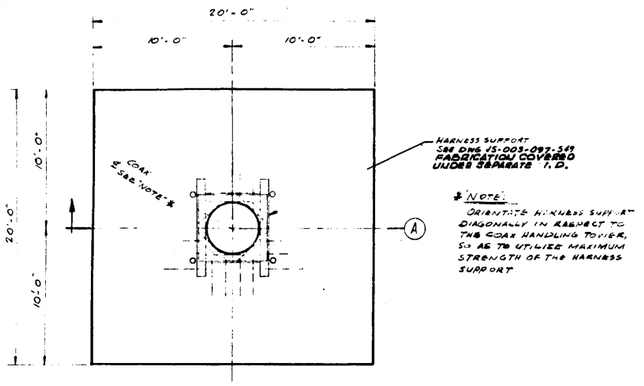
SUBMITTED Holmes & Narver, Inc. | AGENCY APPROVAL REFERENCE NO. RH Robertson | APPROVED A.E.C.

HOLMES & NARVER, INC.
ENGINEERS—CONSTRUCTORS
SPECIAL PROJECTS DIVISION
849 SOUTH BROADWAY LOS ANGELES 14, CALIFORNIA

DRAWING NUMBER JS-003-U-3ax-S2.1

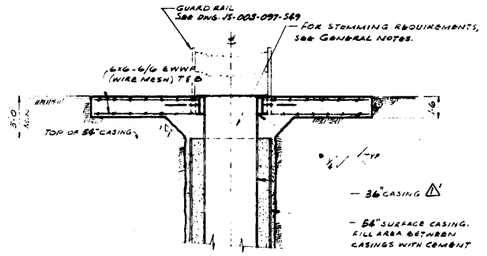
W.O. 1225-09

Figure 4. U3ax Satellite Holes (Drawing # JS-003-U-3ax-S2.1)



*NOTE:
ORIENTATE HARNESS SUPPORT DIAGONALLY IN RESPECT TO THE COAX HANDLING TOWER, SO AS TO UTILIZE MAXIMUM STRENGTH OF THE HARNESS SUPPORT.

PLAN
SCALE-NONE



SECTION A
SCALE-NONE

GENERAL NOTES

1. CONCRETE DEVELOPED A MINIMUM OF 3,000 P.S.I. IN SEVEN(7) DAYS USING TYPE 2 CEMENT IN ACCORDANCE WITH APPROVED MIX DESIGN.
2. THE FIRST APPROX. 1610 CU. YD'S OF STEM WAS WITH MAGNETITE SAND WITH THE FOLLOWING SPECIFICATIONS
   a. BULK SPECIFIC GRAVITY NOT LESS THAN 3.0.
   b. PASS A #10 SCREEN, NOT PASS A #100 SCREEN.
   c. DRY SAND PREFERRED; 2% TO 6% (BY WT.) OR LESS MOISTURE ACCEPTABLE.
3. STEMMING WERE DONE AT USER'S DIRECTION AND AFTER HOLE HAS BEEN INSTRUMENTED APPROX 164 CU. YDS.
4. SAND SPECIFICATIONS:
   a. SAND PASSED THRU A 1/4" SCREEN & MUST BE RETAINED ON A #16 SCREEN. FINE WILL BE LIMITED TO NOT MORE THAN 5% PASSING A #100 SIEVE.
   b. SAND WATER CONTENT WAS GREATER THAN 1% AND LESS THAN 2% BY WEIGHT.
5. THE SAND NEED NOT BE WASHED IF IT WILL PASS SPECIFICATIONS, OTHERWISE, AFTER IT IS WASHED & DRIED (ASSUMING THE PRESENT METHOD OF AIR DRYING IS USED), IT SHALL BE REPROCESSED OVER A #16 SCREEN BEFORE SHIPPING TO THE AREA. SAND BEING DRIED SHALL BE REDUCED ONLY TO 2% MOISTURE CONTENT BEFORE RESCREENING. AFTER THE FINAL SCREENING, EVERY EFFORT SHALL BE MADE TO KEEP THE SAND DRY & TO KEEP WIND BLOWN FINES OR WATER FROM MIXING WITH IT. THE SAND STOCKPILE MUST ALWAYS BE PROTECTED BY A WATERPROOF & DUSTPROOF COVER, AFTER THE FINAL PROCESSING, UNTIL IT IS USED.

REFERENCE D.W.G

JS-003-097-549 HARNESS SUPPORT
JS-003-002-C7 LOCATION PLAN

INDEX CODE						
AREA	BLDG or STA	CLASS	TYPE	A.&E.	SHT NO	USER
03	U3bl	33	36	001	51	03

AS-BUILT
HOLMES & NARVER, INC.
Engineers — Constructors
Date 8/24/62 | By P.J | CKD R. Bullard
Approved 8-30-62

NO.	DATE	REVISIONS	BY	CK.	H & N	A.E.C. APP.
3	8-24-62	AS BUILT - REVISED GENERAL NOTES.	P.J.	K.B.		
2	7-11-62	ADDED NOTE #5 REV. NOTE #4	D.W.G.			
1	4-11-62	CHANGED CASING FROM 28"ID TO 36"ID REVISED REF. DWG No & NOTE 2 FROM SCREEN TO 1/4 SQUARE	D.W.G.			

I.D. NO. 182752

U. S. ATOMIC ENERGY COMMISSION
ALBUQUERQUE OPERATIONS OFFICE

CONCRETE PAD FOR 36"I.D. CASING
PLAN & SECTION
STA U3bl AREA 3

DESIGNED BY
DRAWN BY D.W.GILL
CHECKED BY
DATE 7-9-62
F.E. 5-62

SUBMITTED HOLMES & NARVER, INC.
APPROVAL REFERENCE NO.
APPROVED G-E-CE A.E.C.

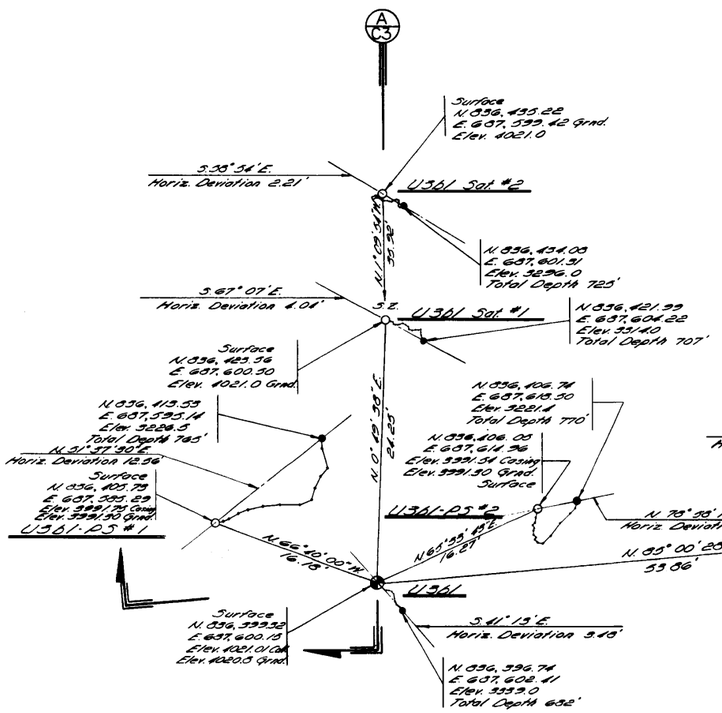
HOLMES & NARVER, INC.
ENGINEERS—CONSTRUCTORS
SPECIAL PROJECTS DIVISION
848 SOUTH BROADWAY LOS ANGELES 14, CALIFORNIA

DRAWING NUMBER JS-003-U3bl-S1.3

32855

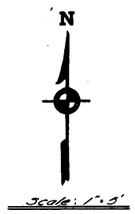
W.O. 1215-38

Figure 5. Surface Construction Plan for U-3bl
(Drawing # JS-003-U3bl-S1.3)



Array Of Drill Holes For Sta. U36l

Scale: 1" = 5'



Reference Dwg's

JS-003-U36l-C3 · Hole Sections
JS-003-034-C2 · Vicinity Map
Sperry-Sun Survey Co. Job # 363, 413, 420, M3 436 & M3 450.

INDEX CODE						
AREA	BLDG or STR.	CLASS	TYPE	A.&E.	ENT. NO.	USBR
03	U36l	33	10	001	C2	03

NO.	DATE	REVISIONS	BY	CK.	H & H	A.E.C. APP.

I.D. NO. 182750

U. S. ATOMIC ENERGY COMMISSION
ALBUQUERQUE OPERATIONS OFFICE

HORIZONTAL DEVIATION OF DRILLED HOLES
PLAN
STA. U36l AREA 3

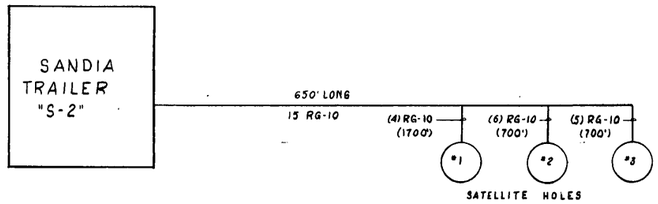
DESIGNED BY
DRAWN BY Don Darron
CHECKED BY
DATE 8-3-1948
F 7-8-49

SUBMITTED HOLMES & NARVER, INC.
AGENCY APPROVAL REFERENCE NO.
A.E.C.

HOLMES & NARVER, INC.
ENGINEERS—CONSTRUCTORS
SPECIAL PROJECTS DIVISION
845 SOUTH BROADWAY LOS ANGELES 14, CALIFORNIA

DRAWING NUMBER
JS-003-U36l-C2

Figure 6. Surface and Subsurface Location of Holes at U3bl
(Drawing # JS-003-U3bl-C2)



NOTES:

1. THE C.P.F.F. CONTRACTOR SHALL FURNISH ALL CONNECTORS & CABLES.
2. THE C.P.F.F. CONTRACTOR SHALL FURNISH ALL OTHER MATERIAL, SUPPLIES & LABOR NEEDED TO COMPLETE WORK AS SHOWN.
3. EACH END OF EACH CABLE SHALL BE FLAG MARKED WITH 2" YELLOW TAPE.
4. AFTER INSTRUMENTATION, BACKFILL HOLE WITH STEMMING SAND TO WITHIN 12S' OF COLLAR & BACKFILL THE REMAINDER OF HOLE WITH CONCRETE.

△2 AS BUILT NOTE:
THE NOTES WERE FOLLOWED AS STATED.

INDEX CODE						
AREA	BLDG or STR.	CLASS	TYPE	A.&E.	ENT. NO.	UNDER
03	U3bl	33	03	003	W2.1	03

AS-BUILT
HOLMES & NARVER, INC.
Engineers — Constructors
Date 10-17-62 | By FARNSWORTH CKD C.L.
Approved 11-3-62

3312.

△2 10-26-62 AS BUILT. REVISED DRAWING. L.F. C.L.

NO.	DATE	REVISIONS	BY	CH.	H & N	A.E.C. APP.

I.D. NO. 182755

U. S. ATOMIC ENERGY COMMISSION
ALBUQUERQUE OPERATIONS OFFICE

SANDIA SATELLITE CABLING SCHEMATIC DIAGRAM
STA. U-3bl PROJ. 43.3 AREA 3

DESIGNED BY
DRAWN BY J. BATH
CHECKED BY
DATE P: 8-2-62 F: 8-7-62

HOLMES & NARVER, INC.
ENGINEERS—CONSTRUCTORS
SPECIAL PROJECTS DIVISION
848 SOUTH BROADWAY LOS ANGELES 14, CALIFORNIA

DRAWING NUMBER JS-003-U3bl-W2.1

W.O. 1216-71A

Figure 7. U3bl Satellite Holes
(Drawing # JS-003-U3bl-W2.1)

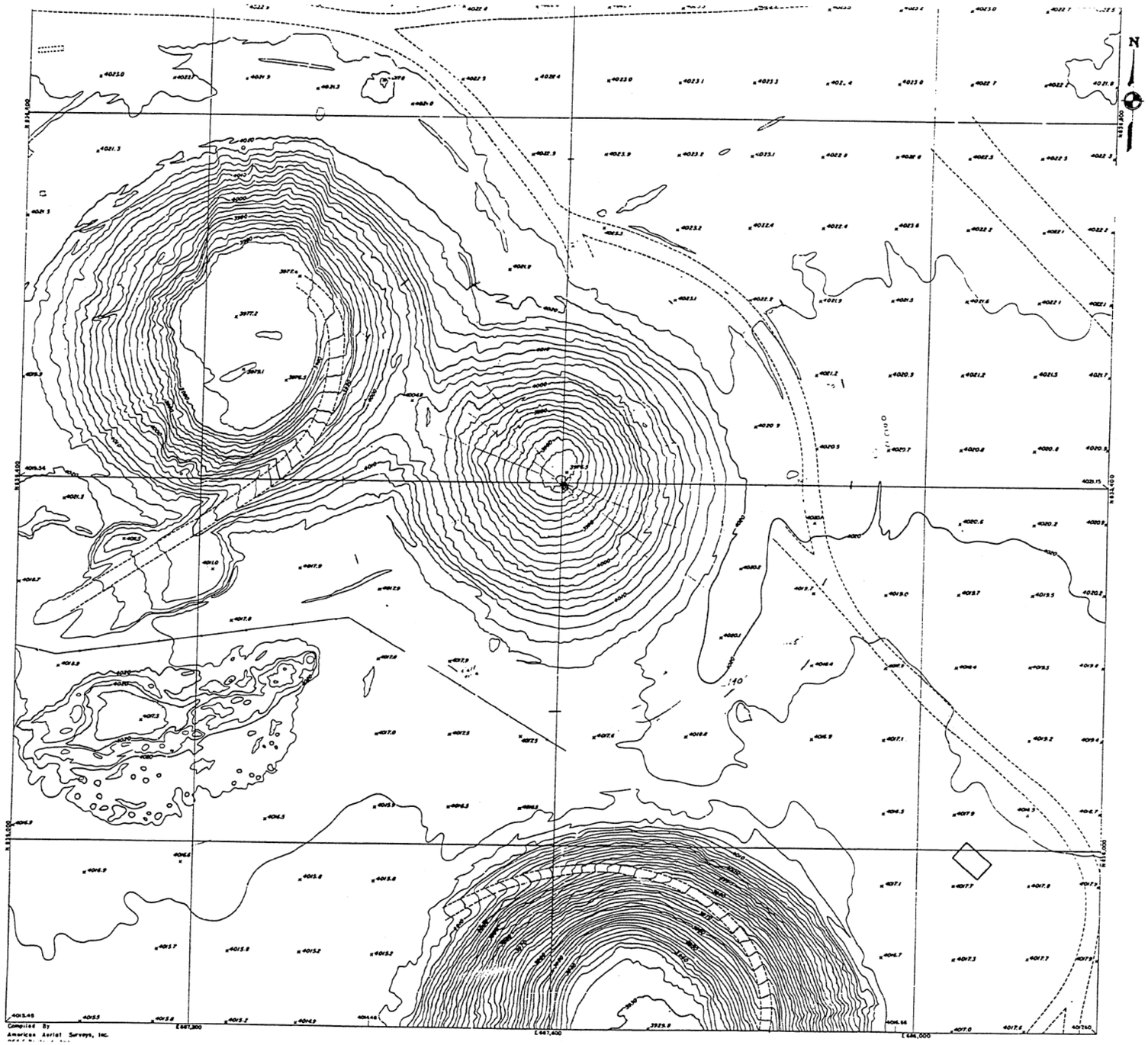


Figure 8. U3ax and U3bl Collapse Craters

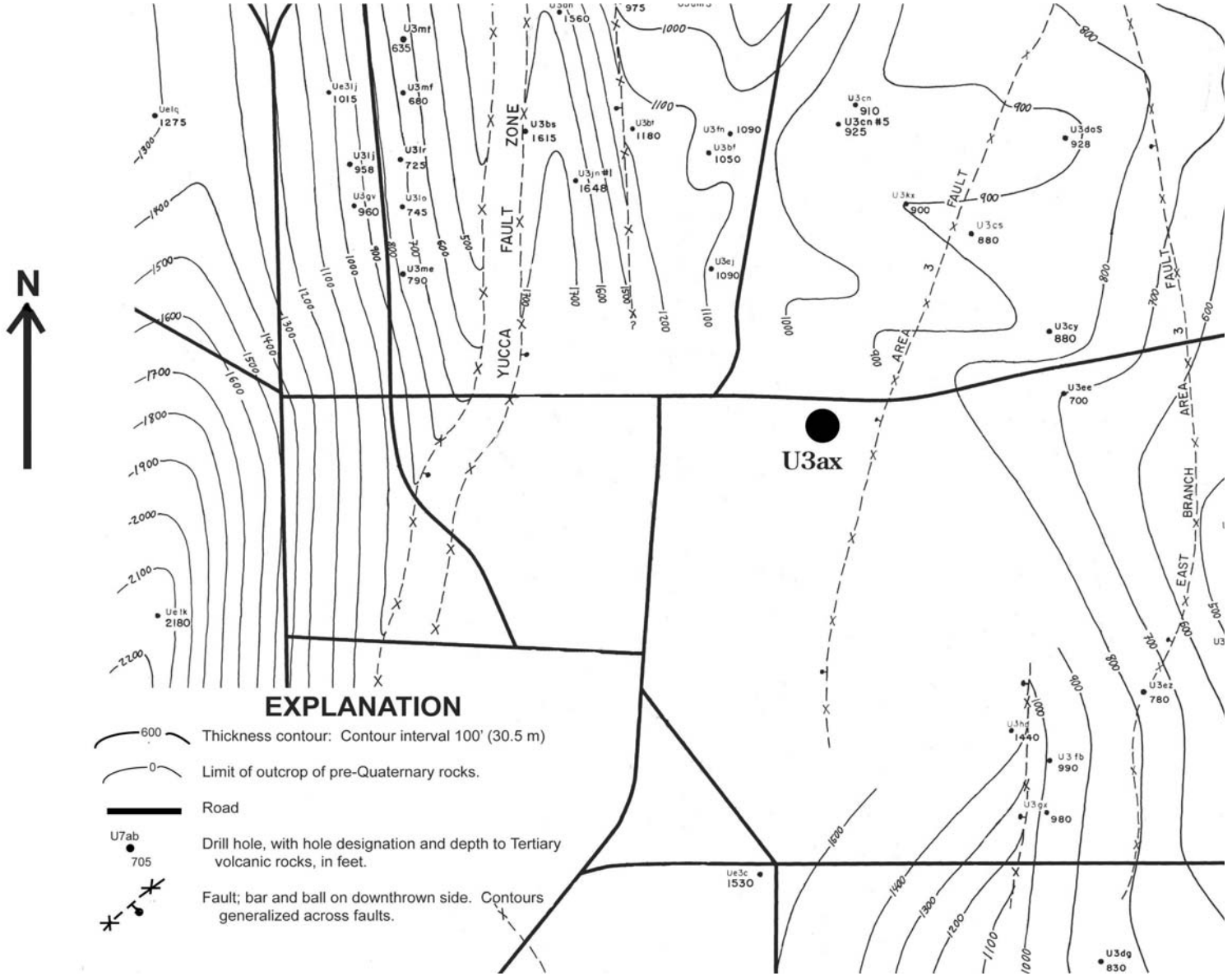


Figure 9. Alluvium Isopach Map for the Area 3 RWMS (Sig Drellack, 1988, Personal Communication)

Appendix A

Hole Histories for RWMS Emplacement Holes

U-3ax
U-3bl
U-3ah
U-3at
U-3az
U-3bh
U-3bg

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax

WORK ORDER NUMBER 1225-08 H & N I.D. NUMBER 12438 E.D.S. NUMBER M-483

USER LASL TYPE HOLE Emplacement

LOCATION: Nevada (NTS) County Nye Area 3

Coordinates N836,550.01 E687,257.55 Surface Elevation 4022.4' Ground

RIG SCHEDULE: MOVED ON LOCATION 1-19-62 SPUDDED 1-20-62 COMPLETED 2-13-62

REMARKS: USER ACCEPTANCE 2-13-62

MUD PROGRAM: Low Fluid Loss of 3cc/30 Min. Wt. 71, VISC 66 P.H. 8 San Content 3.5%

(No record of total bbls. of mud used)

DRILLING EQUIPMENT Term. #6, Emsco 500.

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	100'	60"	54"	352	33	B/W	0'	100'	500 cu
100'	875'	42"	30"	198	33	B/W	72'	870'	3040 "
875'	877'	15"							

TOTAL DEPTH 877' WORKING POINT 856.76 PLUGS None

JUNK None

LOGGING DATA Lane Wells logs: Induction 600'-877', Focused -600'-877'. Electric log 600'-77' Acoustilog 600'-874', Temperature log 700'-878', Gamma-ray Neutron 700'-877', Electric log 680'-881'. Sperry Sun directional survey (0' to 850').

DEVIATION DATA: M.D. 850' V.D. 850' REFERENCE SUR-138

BOTTOM HOLE COORDINATES N836,551.79 E687,256.42 (2.11' @ N32°25'W)

CORING HISTORY Cored 855' to 865' with no recovery. Cored 865' to 875', with 8' recovery.

Well History
U-3ax

1-19-62	Moving in and rigging up.
1-20-62	Rigged up and drilled 26" hole to 32'. Grouted in conductor pipe.
1-21-62	Drilled 26" hole from 32' to 110'.
1-22-62	Opened 26" hole to 36" from 0' to 108'.
1-23-62	Opened 36" hole to 60" from 0' to 65'.
1-24-62	Opened 36" hole to 60" from 65' to 100'. Ran 54" casing.
1-25-62	Set 54" casing at 100'. Cemented with 500 cu ft. of common cement with (2% gel. & 2% $CaCl_2$). No cement returns to surface. Drilled 15" hole to 174'.
1-26-62	Drilled 15" hole from 174' to 609'.
1-27-62	Drilled 15" hole from 609' to 855'. Cored from 855' to 865' with no recovery. Cored from 865' to 875' with 8' recovery. Drilled 15" hole to 875'.
1-28-62	Ran Lane Wells logs. Opened 15" hole to 26" from 100' to 708'.
1-29-62	Opened 15" hole to 26" from 708' to 877'.
1-30-62	Rigged up to open hole to 42". Rig secured from 0630 hours to 1200 hours. Opened 26" hole to 42" from 100' to 126'.
1-31-62	Opened hole from 26" to 42" from 126' to 331'.
2-1-62	Opened hole from 26" to 42" from 331' to 535'.
2-2-62	Opened hole from 26" to 42" from 535' to 586'.
2-3-62	Opened hole from 26" to 42" from 586' to 776'.
2-4-62	Opened hole from 26" to 42" from 776' to 850'.
2-5-62	Opened hole from 26" to 42" from 850' to 875'. Ran mandrel to 872'. Rigged up to run 30" casing.
2-6-62	Ran 30" casing to 870', with disconnect collar at 72'. Cemented with 3340 cu ft. cement with 1% pre-hydrated gel.
2-7-62	Ran 26" bit in hole and found top of cement at 857'. Ran Sperry Sun directional survey.
2-8-62	Rig secured 4 hours. Ran mandrel to 857'.

Well History
U-3ax 'cont'd'

2-9-62	Rig secured 7 hours. Ran pump and pumped hole dry.
2-10-62	Swabbed hole and ran mandrel to 857'.
2-11-62	Swabbed and bailed hole dry. Began tearing out rig.
2-12-62	Rigged down and cut conductor pipe.
2-13-62	Completed rigging down and hole completed.

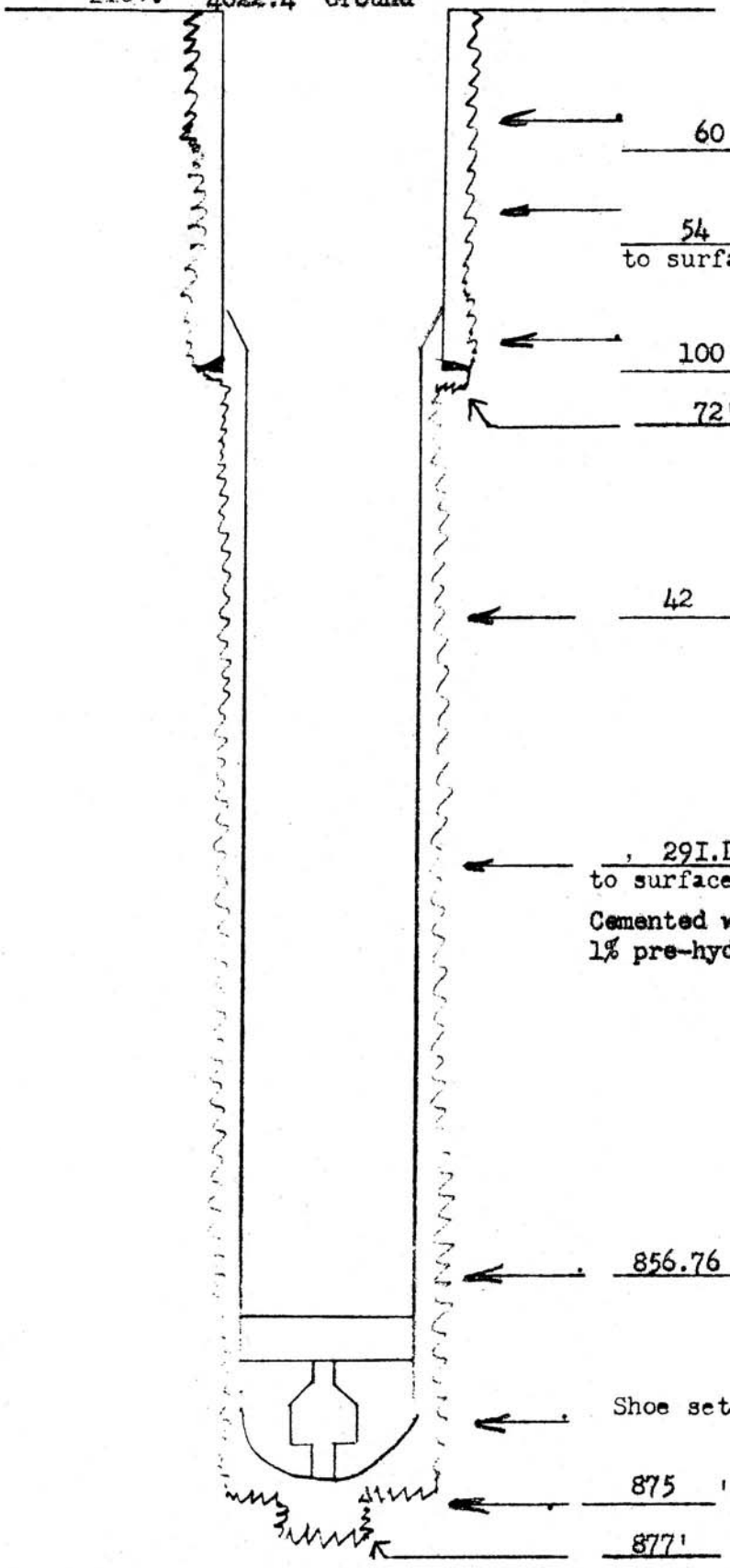
ARB:jf

EMPLACEMENT HOLE

550.01 U-3ax

Coordinates: N 836,~~549.66~~,E 687,257.~~10~~55

Elev. 4022.4 Ground



60 "Diameter Hole

54 " 352 # Casing cemented to surface in 60 "Dia. Hole

100 ' Depth of 60 " Hole.

72' Tpp of disconnect collar

42 "Diameter Hole

, 29I.D" 198 # Casing cemented to surface in 42 " Diameter hole. Cemented with 3040 c/f cement plus 1% pre-hydrated gel.

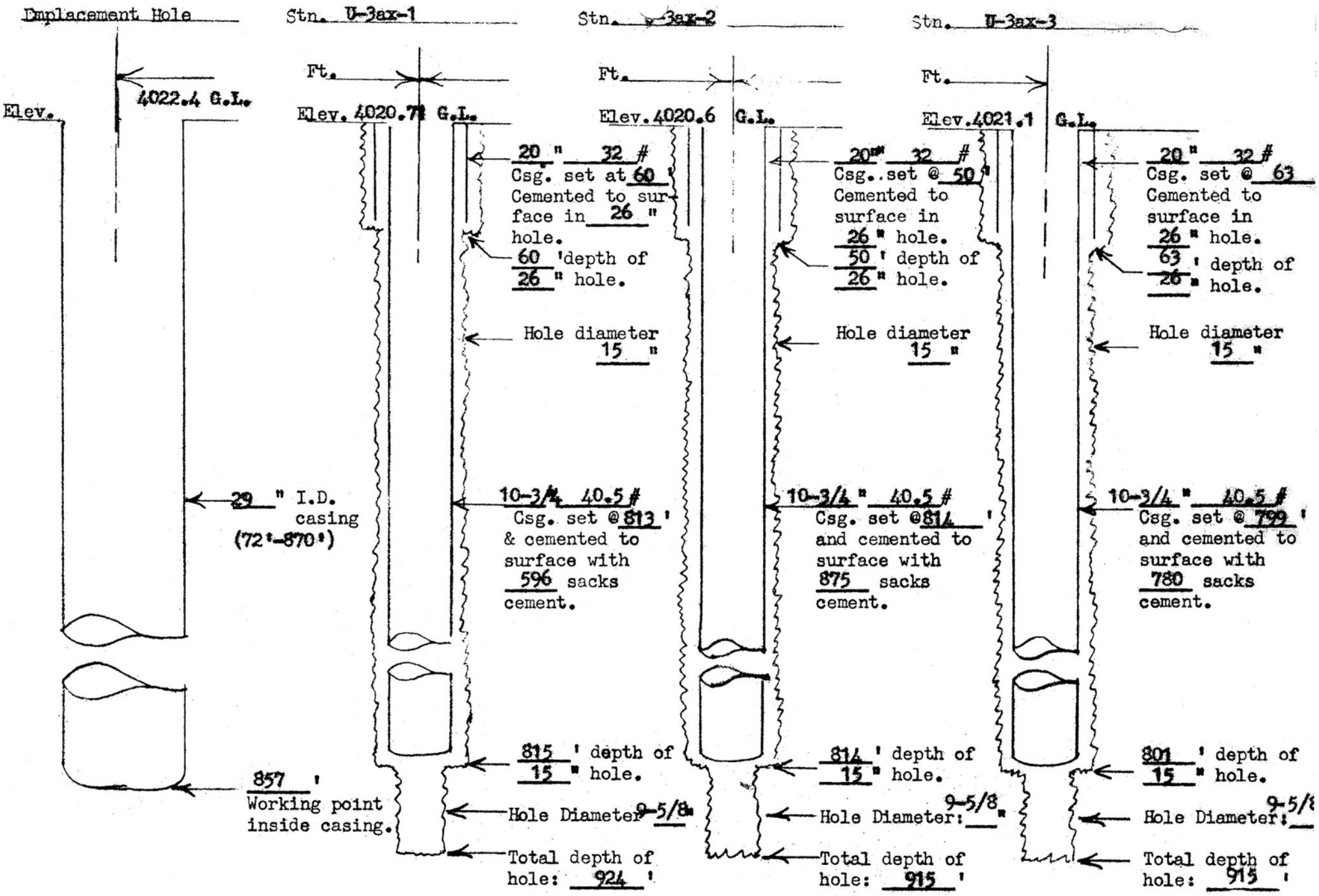
856.76 ' Working Point inside casing.

Shoe set @ 870 ',

875 ' Depth of 42 " hole.

877' Depth of 15" hole.

ARR:


Emplacement Hole
Stn. U-3ax-1
Stn. U-3ax-2
Stn. U-3ax-3
Ft.
Ft.
Ft.
Elev.
4022.4 G.L.
Elev. 4020.7 G.L.
Elev. 4020.6 G.L.
Elev. 4021.1 G.L.
20 " 32 # Csg. set at 60 ' Cemented to surface in 26 " hole.
60 ' depth of 26 " hole.
Hole diameter 15 "
20" 32 # Csg. set @ 50 ' Cemented to surface in 26 " hole.
50 ' depth of 26 " hole.
Hole diameter 15 "
20 " 32 # Csg. set @ 63 Cemented to surface in 26 " hole.
63 ' depth of 26 " hole.
Hole diameter 15 "
29 " I.D. casing (72'-870')
10-3/4 40.5 # Csg. set @ 813 ' & cemented to surface with 596 sacks cement.
10-3/4 " 40.5 # Csg. set @ 814 ' and cemented to surface with 875 sacks cement.
10-3/4 " 40.5 # Csg. set @ 799 ' and cemented to surface with 780 sacks cement.
857 ' Working point inside casing.
815 ' depth of 15 " hole.
814 ' depth of 15 " hole.
801 ' depth of 15 " hole.
Hole Diameter 9-5/8"
Hole Diameter: 9-5/8"
Hole Diameter: 9-5/8
Total depth of hole: 924 '
Total depth of hole: 915 '
Total depth of hole: 915 '

ARR

HOLMES & NARVER INC.,
WELL HISTORY DATA
REVISED WELL HISTORY

HOLE NUMBER U-3h1

WORK ORDER NUMBER 1215-29-A H&N I.D. NUMBER 182751-A E.D.S. NUMBER

USER LASL TYPE HOLE Emplacement

LOCATION Nevada (NTS) County Nye AREA 3

Surface Coordinates N836,399.32 E687,600.15 Ground Elevation 4021.01 Cellar

RIG SCHEDULE: MOVED ON LOCATION 6-10-62 SPUDDED 6-12-62 COMPLETED 6-21-62

REMARKS No lost circulation

CIRCULATING MEDIA Water, gel & chemicals, 3660 bbls. of mud delivered to well from mud plant.

No OF COMPRESSORS & SIZE

DRILLING EQUIPMENT EMSCO 500

E HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I.D.	WT/FT.	WALL THICK.	GRADE	COUPLING	FROM	TO	CU. FT. CEMENT
0'	20'	64"	52"	Conductor pipe				0'	20'	200 cu.f
0'	690'	48"	36"	294#		J-55	BW	0'	685'	3800 cu.f
690'	693'	36"								

TOTAL DEPTH 693' MANOREL DEPTH 682.70' PLUGS None

JUNK None

LOGGING DATA Sperry Sun Gyroscopic Multishot survey from surface to 682'.

DEVIATION DATA M.D. 682' V.D. 682' REFERENCE SUR 368

HOLE COORDINATES @ N836,396.74 E687,602.41

CORING HISTORY NONE TAKEN

REVISION March 9, 1963 DATE March 9, 1963

WRITTEN BY CHECKED BY

Well History
Stn. U-3b1

6-2-62 Bucket drill rig moved in and drilled 20' of 64" hole. Cemented one joint of 52" casing at 20' with 200 cu ft. of neat cement, cemented to surface.

6-10-62 Moved in Emsco 500 and started to rig up.

6-11-62 Rigged up.

6-12-62 Spudded in at 4:00 AM and drilled 15" hole to 695' using mud as a circulating media. Opened 15" hole to 26" from 20' to 96'.

6-13-62 Opened 15" hole to 26" from 96' to 611'.

6-14-62 Opened 15" hole to 26" from 611' to 695'. Opened 26" hole to 36" from 20' to 610'.

6-15-62 Opened 26" hole to 36" from 610' to 693'. Opened 36" hole to 48" from 20' to 428'.

6-16-62 Opened 36"hole to 48" from 428' to 647'.

6-17-62 Opened 36" hole to 48" from 647' to 690'. Conditioned mud to run casing.

6-18-62 Ran 36" casing to 685'.

6-19-62 Cemented 36" X 3/4" wall casing at 685' thru 5 9/16" drill pipe, which was stabbed into Baker float shoe, with 3600 cu ft. of cement pre-mixed with 1% pre-hydrated gel. Full returns of cement at surface. Landed 36" casing. Measured in with 26" bit to 682.82'. Measured in with 34½" mandrel checked top of cement at 682.61'. Had to roll off at 38', 50' & 359'. Ran Sperry Sun Gyroscopic Multishot survey from surface to 682'.

6-20-62 Ran in with casing scraper and scrapped hole from surface to 683'. Bailed fluid out of hole.

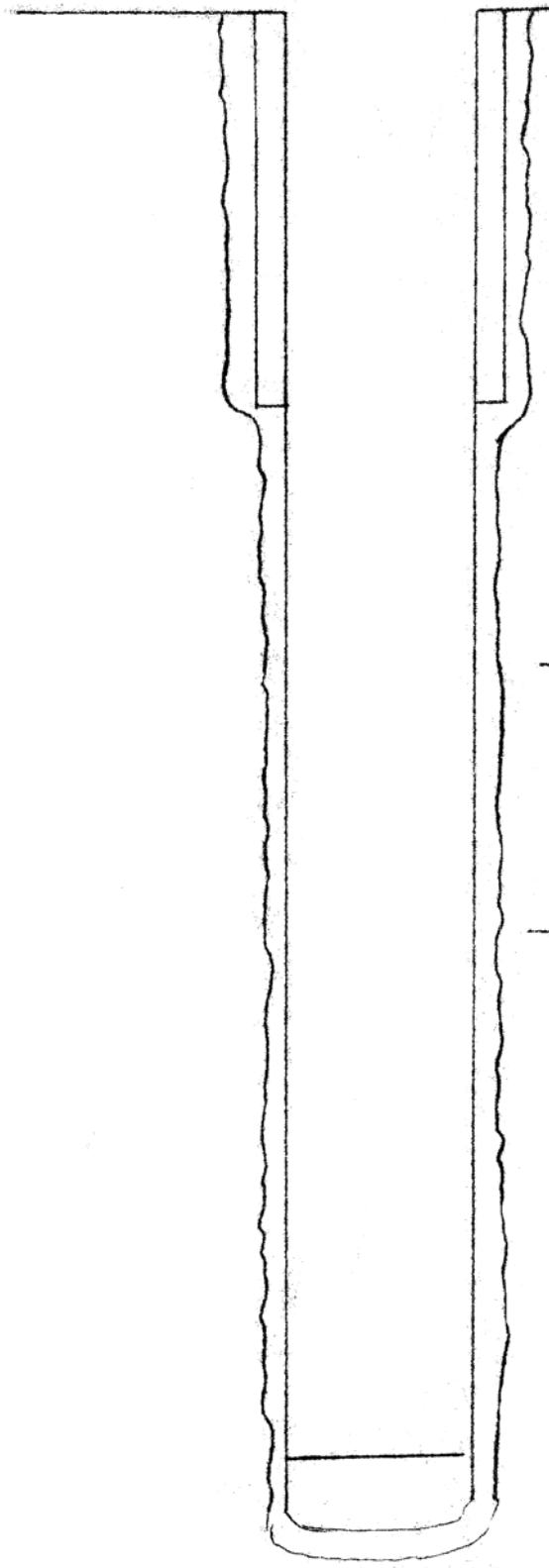
6-21-62 Swabbed hole dry and clean. Measured in with 34½" mandrel to check working depth at 682.70'. Laid down drill pipe and started to tear out. Well completed.

Emplacement HOLE

Stn. U-3bl

COORDINATES: N. 836,399.32 E. 687,600.15

ELEV. 4021.01



20'

64 " Diameter Hole

20'

53¼ " ID 352 # Casing Cemented to surface in 64 " Diameter Hole

690' 48 " Diameter Hole

685' 36 " 294 # Casing Cemented to Surface in 48 " Diameter Hole

682.70' Inside Total Depth

BOTTOM COORDINATES N. 836,396.74 E. 687,602.41

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ah

WORK ORDER NUMBER 1210-12 H & N I.D. NUMBER 182350 E.D.S. NUMBER M-116

USER LASL TYPE HOLE Large Diameter Cased Hole, Emplacement

LOCATION: Nevada County Nye Area 3

Coordinates N836,286.80' E686,481.05' Surface Elevation 4020.24'

RIG SCHEDULE: MOVED ON LOCATION 9-16-61 SPUDDED 9-17-61 COMPLETED 11-22-61

REMARKS: USER ACCEPTANCE 11-22-61

MUD PROGRAM: Low Water Loss, Oil Emulsion Mud. Fluid Loss less than 2cc/30 mins., Sand content less than 3%.

DRILLING EQUIPMENT Terminal #18, Ideco #525.

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	89'	48"	44"	346#	D	B/W	0'	89'	210
~~90~~ 89	1210'	42"	37½"	294#	D	B/W	0'	306.33'	800
1210'	1215'	26"	24"	126#	D	B/W	283'	1204'	4150

TOTAL DEPTH 1211' WORKING POINT 1200' PLUGS

JUNK none

LOGGING DATA Schlumberger (10-8-61) Gamma Ray/Neutron (90'-1200'), Sonic Log (90'-1200'), Temperature Log (90'-1200'), Electric Log (90'-1200'), & Sperry Sun Gyroscopic Survey (11-13-61) 0'-1200'.

DEVIATION DATA: M.D. 0°55' V.D. 1200' REFERENCE SUR No. 23

BOTTOM HOLE COORDINATES 1.54' N39.5°W. (from hole center)

CORING HISTORY Core # 1 (1198'-1202'), Core # 2 (1202' -1205'), Recovered 1'.

WELL HISTORY
U-3ah

9/16/61 Rig up (morning tour only).

9/17/61 Rig up

9/18/61 Spud. Drilled 26", 0' to 50'.

9/19/61 Drilled 26" hole 50' to 102'. Opened 26" hole to 36" from 0' to 93'.

9/20/61 Opened 36" hole to 48" from 0' to 89'.

9/21/61 Ran 44" O.D. casing to 70' where it stopped. Pulled out and layed down casing

9/22/61 Finished laying down 44" casing, reassembled table and re-reamed hole 0'to 89'

9/23/61 Re-ran 44" casing, Ran 101' of 44" O.D. B-W casing, with shoe @ 90' below ground level. Cemented with 130 sacks common plus 130 cu. ft. Pozmix plus 3% $CaCl_2$. Cut off cond., weld F.L., Nipple up while W.O.C.

9/24/61 Cleaned mud pits, welded up stabilizers. Ran in and found top of cement @ 90'. Drilled 26" hole to 115'. 2 major crew accidents this day.

9/25/61 Drilled 26" hole, 115' to 237'. 9/25 to 9/30/61 Drlg 26" hole from 115' to 1199' on 44"/32 ppf Seamless pipe — hrs

9/26/61 Drilled 26" hole, 237' to 317'.

9/27/61 Drilled 26" hole, 317' to 396'.

9/28/61 Drilled 26" hole, 396' to 534'.

9/29/61 Drilled 26" hole, 534' to 605'.

9/30/61 Drilled 26" hole, 605' to 652'.

10/1/61 Drilled 26" hole, 652' to 675'. Secured by A.E.C. for 11 hours.
Drilled 26" hole, 675' to 706'.

10/2/61 Drilled 26" hole, 706' to 810'.

10/3/61 Drilled 26" hole, 810' to 972'.

10/4/61 Drilled 26" hole, 972' to 1014'.

10/5/61 Drilled 26" hole, 1014' to 1110'.

10/6/61 Drilled 26" hole, 1110' to 1164'.

10/7/61 Drilled 26" hole, 1164' to 1190'.

10/8/61 Drilled 26" hole, 1190' to 1199'. Core No. 1, 1199' to 1202'. Cut 4', Recovery (not recorded). Rig to run Schlumberger logs. Ran Gamma Ray-Neutron, Sonic Temperature, and Electric logs. Ran Eastman directional survey.

10/9/61 Load out Eastman, took core No. 2, 1202' to 1205', Cut 3', Recovered 2'. Drilled 26" hole 1205' to 1213'.

10/10/61 Drilled 26" hole 1213' to 1215'. Rig secured by AEC for 6 hours. Ream 26" hole to 42" from 90' to 172'.

10/11/61 Reaming 26" to 42" from 172' to 453'.

10/12/61 Reaming 26" to 42" from 453' to 493'.

10/13/61 Reaming 26" to 42" from 493' to 602'.

10/14/61 Reaming 26" to 42" from 602' to 714'.

10/15/61 Reaming 26" to 42" from 714' to 947'.

10/16/61 Reaming 26" to 42" from 947' to 1035'.

10/17/61 Reaming 26" to 42" from 1035' to 1070'.

10/18/61 Reaming 26" to 42" from 1070' to 1110'.

10/19/61 Reaming 26" to 42" from 1110' to 1172'.

10/20/61 Reaming 26" to 42" from 1172' to 1210'.

10/21/61 Re-reamed 42" with 42" Grant reamer. Re-reamed from 90' to 614'.

10/22/61 Re-reamed 614' to 1210'.

10/23/61 Conditioned mud, slipped line and re-reamed 42" hole to 1210'.

10/24/61 Re-ream hole and condition mud. Rig to run 36" I.D. casing. Run 36" I.D. casi

10/25/61 Ran 6 joints (280') of 36" I.D. x 3/4" wall B/W casing.

10/26/61 Ran 36" casing to 306'. Pipe stopped. Pulled 260,000 pounds, could not move. Ran drill pipe and poor boy swivel. Circulated to free pipe, could not move.

10/27/61 Pulling on 36" casing and breaking circulation once every hour. No recovery Rig to jack on casing.

10/28/61 Jacking on casing with 50 ton jacks and taking 200,000# pull. Circulated oil to try freeing casing, could not free. Rig to cement casing.

10/29/61 Cemented with 1224 cu. ft. of common cement with 2% dry gel and 2% $CaCl_2$. Drill pipe hung @ 303', no returns to the surface. W.O.C. Rig secured for 6 hours by AEC. Landed casing.

10/30/61 Rig for drilling. Jar on casing shoe. Run in with 26" bit to drill out shoe.

10/31/61 Drilled out casing shoe. Ran to 1201' with 26" bit. No fill. Re-reamed hole 306' to 1210'.

11/1/61 Condition hole. Rig to run 24" casing, ran 8 joints (304.48')

11/2/61 Running 24" casing. Ran total 725.5' to date.

11/3/61 Running 24" casing on Chancellor disconnect collar. shoe at 1208'.

11/4/61 Rig to run 2-7/8" tubing. Ran to 1204' where backed off. 185' fish in hole. Top of fish at 1150'. Pulled 24" casing to floor and cut off disconnect collar. Recovered part of fish.

11/5/61 No record of activity.

11/6/61 Felt for shoe of 24" casing. could not find. Rig to pull 24" casing. Pulled 24" casing and layed down in 80' joints. Made bit run to 1210' to condition hole. Repair casing shoe.

11/7/61 Rig to re-run 24" casing. Ran in 24" casing to top of disconnect collar.

11/8/61 Ran 906', 5-9/16" drill pipe stinger. Ran 24" casing to 1208'. Top of disconnect collar at 283.72'. Rig to cement. Cemented with 4500 cu. ft. of common neat cement and 900 cu. ft. of pre-hydrated gel. Circulated from around disconnect, pulled 2-7/8" tubing out of hole. Cement in place @ 12 noon.

11/9/61 W.O.C. for 10 hours. Disconnected Chancellor collar @ noon. Cleaned c cement out of 24" casing (13' fill), 40' of cement in drill pipe. Rig to run 17-1/2" bit.

11/10/61 Ran to 1143' (top of cement). Drilled cement with 17-1/2" bit to 1200'. Reamed casing 1139' to 1200'. Made 2 trips to condition mud.

11/11/61 Circulated and conditioned mud for 17 hours. Rig to run B-J submersible pump.

11/12/61 Ran B-J pump to 1172'. Ran pump for 2 hours and stopped. Pulled pump, could not repair. Laid down 5-1/2" casing and pump. Rig to bail hole dry.

11/13/61 Ran Sperry Sun Directional Survey. Ran 21" mandrel, stopped at 312'. Re-scraped 24" casing to 1200'. Circulate hole clean. Rig to re-run mandrel.

11/14/61 Re-ran mandrel, stopped at 252'. Pulled and laid down mandrel. Rig to bail. Bailed to 400'. Re-ran mandrel to 1200'±. Set screws on lid of mandrel sheared dropping mandrel to bottom. Top of fish @ 1149'. Make up fishing tools. Ran inside fish to 1198'. No recovery .

11/15/61 Spotted 200# of sand in fish. Hooked up Halliburton to fill hole. Ran in with drill pipe and cemented drill pipe in fish with 60 cu. ft. of Cal-Seal, W.O.C for two hours. Pulled out with fish. Rig to bail. Bailed hole to 1140'

Cont. pn page 4

11/16/61 Bailed to 1170'. Rig to run velocity surveys. U.E.D. velocity surveys for 12 hours. Bailed to 1200'.

11/17/61 Rigged swab. Swabbed hole dry. Ran cannister mandrel to 1182'. Rig to fill hole. Filled hole with mud, ran 17-1/2" bit to 1171'.

11/18/61 Filling hole with mud. Drilled cement from 1182' to 1200'. Ream hole with 22-3/4" scraper from 1182' to 1200'. Rig to bail.

11/19/61 Bailing. Finished bailing to hole. Ran mandrel to 1200'. User accepted. Laying down drill pipe.

11/20/61 Swabbed hole dry. Started to rig out. User requested another cannister run. Ran mandrel to 1200'. Pulled out laying down. Rigging out.

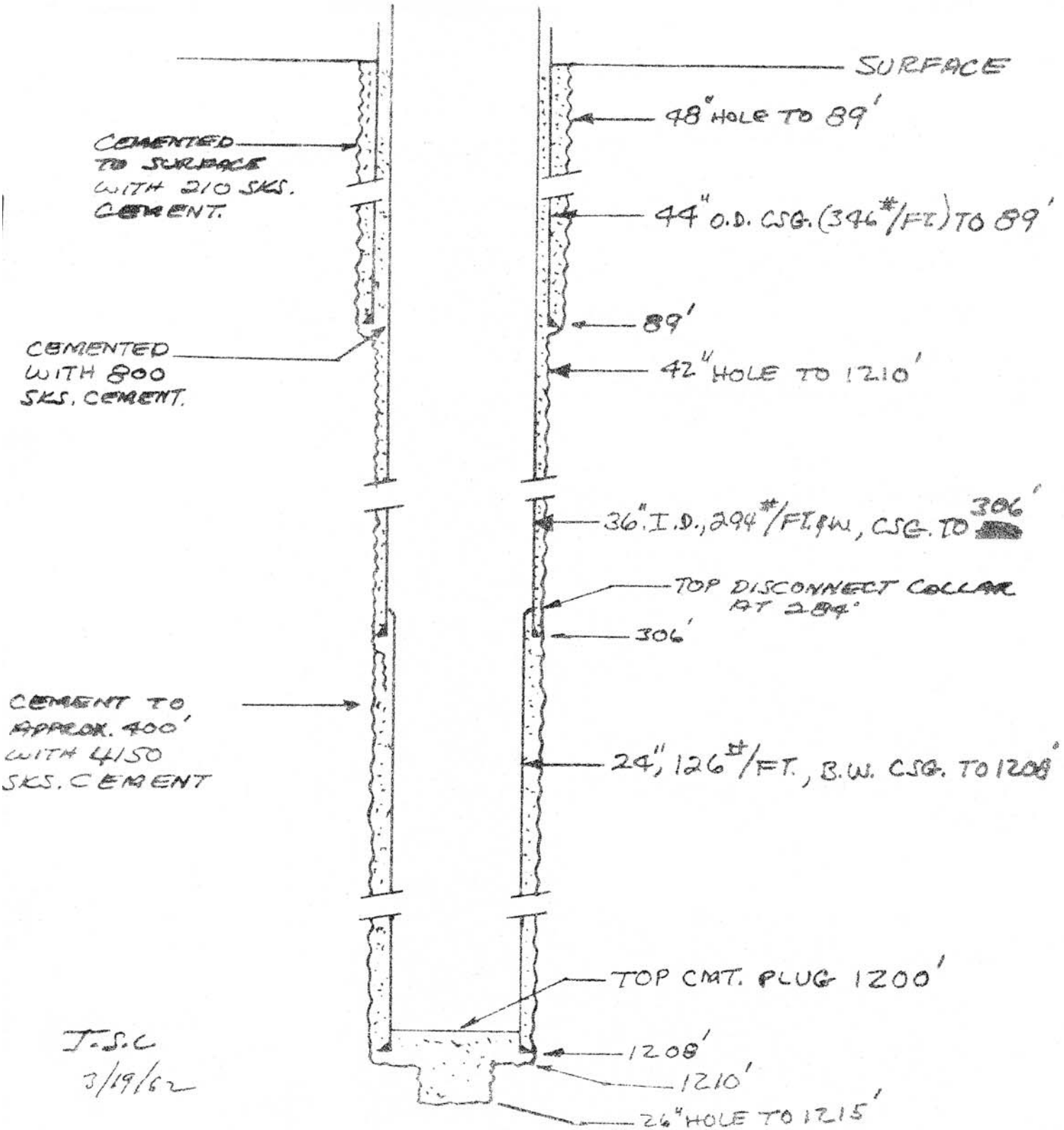
11/21/61 Tearing out. Moving completed

JSL/hh

AS BUILT SKETCH

U-3ah

COMPLETED
11/20/62



J.S.C
3/19/62

HOLMES & NARVER, INC.
WELL HISTORY DATA
REVISED COVER SHEET

HOLE NUMBER U-3at

WORK ORDER NUMBER 1211-19 H & N I.D. NUMBER 182315 E.D.S. NUMBER M-171

USER LASL TYPE HOLE Emplacement

LOCATION: Nevada(NTS) County Nye Area 3

Coordinates N835 798.37 (9.15) E 686,828.93 (6) Surface Elevation 4015.5 Ground

RIG SCHEDULE: MOVED ON LOCATION 1-9-62 SPUDDED 1-10-62 COMPLETED 2-15-62

REMARKS: Top of disconnect collar 80 32 USER ACCEPTANCE 2-15-62

MUD PROGRAM: Gel, Lignite, CMC, Caustic and Quebracho.

Total mud used (incomplete record) 340 bbls.

DRILLING EQUIPMENT Ideco H-525 - Terminal # 18

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0	100'	60"	54"	352#	J-55	B/W	0	100'	500
100'	1010'	42"	29"	198	J-55	B/W	0	1005'	4000
1010'	1015'	26"							

TOTAL DEPTH 1015' WORKING POINT 999.74 PLUGS None

JUNK None

LOGGING DATA Sperry Sun Gyroscopic Multishot Survey 0-1000'

Lane Wells Surveys 0-1010' (Two runs), Gamma Ray/Neutron, Temperature,

Induction, Acoustilog and Focused.

DEVIATION DATA: M.D. 1000' V.D. 1000' REFERENCE 151 - SUR 146

BOTTOM HOLE COORDINATES N 835,799.26 E 686,830.40 (1.72 @ N 58° 48'E)

CORING HISTORY 990 - 1000' Rec. 8'

855 - 865' Rec. 6'

WELL HISTORY
U-3 at

1/9/62 Started move in and rig up. Terminal Rig #18 (Ideco H-525)

1/10/62 Drilled 26" hole to 104'.

1/11/62 Drilled 26" hole to 104 - -123'. Opened 26" hole to 36" to 105'.

1/12/62 Opened 36" hole to 60" to 60'.

1/13/62 Opened 36" hole to 60" to 96'.

1/14/62 Opened 36" hole to 96" to 100'. Ran 54" casing to 100' and cemented with 500 sacks cement thru 5-9/16" drill pipe hung at 96'. Cut off and landed casing.

1/15/62 Center punched 15" hole and drilled to 315'.

1/16/62 Drilled 15" hole 315' - 612'.

1/17/62 Drilled 15" hole 612' - 855'.

1/18/62 Rig secured 8 hours. Cored 855 - 865', recovered 6'. Opened core hole to 15" and drilled 15" hole 865 - 880'.

1/19/62 Conditioned mud and ran following Lane Wells logs: Gamma Ray/Neutron, Temperature, Acoustilog, Focus Log and Electrolog from 100' to 880'. Opened 15" hole to 26" from 100' to 393'.

1/20/62 Opened 15" hole to 26" from 393' to 692'.

1/21/62 Opened 15" hole to 26" from 692' to 842'.

1/22/62 Opened 15" hole to 26" from 842' to 880'. Opened 26" hole to 42" from 100' to 119'.

1/23/62 Opened 26" hole to 42" from 119' to 269'.

1/24/62 Opened 26" hole to 42" from 269' to 324'. Drilled 15" hole 880' to 896'.

1/25/62 Drilled 15" hole 896' to 929'. On round trip to change bits bit fell @ 880' - junk on bottom?

1/26/62 Ran magnet to bottom - no recovery. Ran in with 15" bit, drilling on junk. Ran 10-5/8" bit and drilled on junk from 929' - 990'.

1/27/62 Ran in with core barrel. Made two dry runs due to fill.

1/28/62 Cored with 8" head 990' - 1000' recovered 8'. Opened core hole to 10-5/8" and drilled ahead from 1000' to 1003' on junk. Recovered small piece of iron fouled up in cones. Opened 10-5/8" hole to 15" from 929' to 1003'. Drilled 15" hole 1003 - 1015'.

1/29/62 Run following Lane Wells Logs: Gamma Ray/Neutron, Temperature, Induction, Acoustilog, and Focused from 800' to 1015'. Opened 15" hole to 26" from 880' - 975'.

1/30/62 Opened 15" hole to 26" from 975 - 1015'.

1/31/62 Opened 26" hole to 42" from 324' - 484'.

2/1/62 Opened 26" hole to 42" from 484' - 603'.

2/2/62 Opened 26" hole to 42" from 603 - 680'.

2/3/62 Opened 26" hole to 42" from 680' - 769'.

2/4/62 Opened 26" hole to 42" from 769' to 841'.

2/5/62 Opened 26" hole to 42" from 841' to 909'.

2/6/62 Opened 26" hole to 42" from 909' to 1001'.

2/7/62 Opened 26" hole to 42" from 1001' to 1010'.

2/8/62 Conditioned mud to run casing.

2/9/62 Rig secured to 8 hours. Checked for fill, hole open to 1010'. Started to run 29" casing.

2/10/62 Running Casing.

2/11/62 Cemented 29" I.D. casing with Baker float shoe @ 1005' with 4000 cubic feet cement with 1% prehydrated gel. Chancellor disconnect collar at 80.32'. Casing has 5/8" wall and weighs 198#/ft. Standing Cemented.

2/12/62 Bleed off pressure, pulled and laid down male end of disconnect collar. Ran in with 26" bit and located top of cement at 1000'. Ran 26-1/2" x 50' mandrel to check w.p. of 1000'. Rigged up B-J pump and started to pump out casing.

2/13/62 Pump blew up - finished removing fluid with bailer. Ran Sperry Sun Gyroscopic Multichsot survey of entire hole.

2/14/62 Swabbed hole dry. Ran 26-1/2" mandrel and checked working point @ 999.74. Witnessed and approved by Holmes and Narver.

2/15/62 Land casing. Rig down. Well completed 2/15/62.

HOLMES & NARVER, INC.
WELL HISTORY DATA

REVISED COVER SHEET

HOLE NUMBER U-3az

WORK ORDER NUMBER 1225-16 H & N I.D. NUMBER 182440 E.D.S. NUMBER M-324

USER LASL TYPE HOLE Emplacement

LOCATION: Nevada (NTS) County Nye Area 3

Coordinates N835,802.90 E 687,693.17 Surface Elevation 4016.00

RIG SCHEDULE: MOVED ON LOCATION 2-16-62 SPUDDED 2-17-62 COMPLETED 3-8-62

REMARKS: USER ACCEPTANCE

MUD PROGRAM: Oil emulsion (specifications were for max. 2cc/30 min. F.L. and less than 3% sand content, wt. 70 to 72, viscosity 50-60 sec. Total bbl used 315 (report incomplete)

DRILLING EQUIPMENT Terminal #18, Ideco #525

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	100'	60"	54"	352	33	B/W	10	98	500
100'	875'	42"	29"	198	33	B/W	0	870	5550
875'	882'	15"							

TOTAL DEPTH 882' WORKING POINT 866' PLUGS 866 to 882'

JUNK None

LOGGING DATA Acoustilog (680'-878'), Focused log (680-870'), Gamma Ray/Neutron(680'-881') Densilog (680' 881'), Induction Electrilog (680' -882'), Temperature to 867', Sperry Sun Directional survey, 0'-865'.

DEVIATION DATA: M.D. 866' V.D. 866' REFERENCE SUR 193 G.L.

BOTTOM HOLE COORDINATES N835,797.15 E687,695.20 (6.32' @ S18°28' E)

CORING HISTORY (855 to 865) Rec. 7'.

WELL HISTORY
U-3az

2-16-62	Rigging up.
2-17-62	Drilled 36" hole to 120'. Reaming 60" to 14'.
2-18-62	Reamed 60" to 100'. Ran and cemented 54" casing at 98', with 500 cu. ft. cement (1% gel).
2-19-62	Drilling 15" hole to 120' to 158'. Rig secured 8 hours by AEC.
2-20-62	Drilling 15" hole from 158' to 581'.
2-21-62	Drilled 15" hole from 681' to 882'. Cored #1, 855' to 865', Rec. 7'. Ran Lane Wells logs: Acoustilog (680'-878'), Focused log (680'-874'), Gamma Ray/Neutron (680'-881'), Densilog (680'-881'), Induction Electrolog (680'-882'), Temperature survey to 867'.
2-22-62	Reaming 15" to 26" from 120' to 648'.
2-23-62	Reaming 15" to 26" from 648' to 880'. Reaming 26" to 42" from 98' to 155'.
2-24-62	Reaming 26" to 42" from 155' to 389'.
2-25-62	Reaming 26" to 42" from 389' to 616'.
2-26-62	Reaming 26" to 42" from 616' to 725'.
2-27-62	Reaming from 26" to 42" from 725' to 800'.
2-28-62	Reaming 26" to 42" from 800' to 875'.
3-1-62	Circulated and conditioned mud. Rig secured 10 hours.
3-2-62	Circulated and conditioned mud. Rigging up to run 30" casing.
3-3-62	Running 30" casing. No retuns on mud while running casing.
3-4-62	Set 30" casing @ 870'. Cemented with 5350 cu. ft. cement with 1% prehydrated gel. Fluid level inside casing at start of cement job was 165', but filled after pumping in 2500 cu. ft. of cement. Fluid level outside of casing @ 100'.

3-5-62	Ran temperature log. (Top of cement outside 30" casing @ 530'). Cemented with 200 cu. ft. down tubing outside of 30" casing and ran temperature log (Top of cement @ 255').
3-6-62	Ran 26" bit and found bottom @ 869.02'. Plug back with 18 cu. ft. of Cal-Seal to 865'. Rigged up to run Sperry Sun.
3-7-62	Ran Sperry Sun log. Ran mandrel to 866'. Ran pump and pumped well dry. Bailed and mopped fluid out of hole.
3-8-62	Finished drying hole. Ran mandrel to 866'. Laying down drill pipe and preparing to move rig.
3-9-62	Tearing down and moving rig to new location. (Morning and day tours).

HOLMES & NARVER INC.
WELL HISTORY DATA

HOLE NUMBER U-3bh

WORK ORDER NUMBER 1215-40 H&N I.D. NUMBER 182760 E.D.S. NUMBER

USER LASL TYPE HOLE Emplacement

LOCATION Nevada (NTS) County Nye AREA 3

Surface Coordinates N835,600.04 E688,400.65 Ground Elevation 4016.9

RIG SCHEDULE: MOVED ON LOCATION 6-16-62 SPUDDED 6-16-62 COMPLETED 7-21-62

REMARKS No rig on job 7-5-62 and from 7-7-62 thru 7-9-62

CIRCULATING MEDIA Air

Nº OF COMPRESSORS & SIZE

DRILLING EQUIPMENT Oilwell 860 to point of Partial Cmt'g. annulus of 29". Portadrill National T-20, Ideco H-35 and Failing 500 at various stages to cement & complete

BORE HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I.D.	WT/FT.	WALL THICK.	GRADE	COUPLING	FROM	TO	CU. FT. CEMENT
0'	80'	64"	42"	354			B/W	0'	80'	472 cu.ft
80'	939'	42"	29"	198		J-55	B/W	0'	870'	2310 cu.ft
939'	1080'	26"								

TOTAL DEPTH 1080' MANDREL DEPTH 717.92' PLUGS Earthen Plug 939'-1080'
Open hole 870'-939'
Cement in 29" 870'-718'

JUNK None

LOGGING DATA Sperry Sun Gyroscopic Multishot Directional survey from o' to 865'.

DEVIATION DATA M.D. 865' V.D. 865' REFERENCE SUR 403

HOLE COORDINATES @ 865' N835,600.27 E688,399.06

CORING HISTORY None taken

REVISION 3-9-63 DATE March 9, 1963

WRITTEN BY CHECKED BY

Well History
Stn. U-3bh

6-7-62 Moved in Bucket rig and drilled 64" hole to 80' Moved out.

6-8-62 Moved in Portadrill and ran and cemented 54" casing at 80' with 472 cu ft. common cement with 2% HA-5. Moved out.

6-16-62 Moved in Oilwell 860 and rigged up. Drilled out shoe and made 15" hole to 612' using air as a drilling media.

6-17-62 Drilled 15" hole from 612' to 1080'. Opened 15" hole to 26" from 80' to 766'.

6-18-62 Opened 15" hole to 26" from 766' to 1080'. Opened 26" hole to 42" from 80' to 368'.

6-19-62 Opened 26" hole to 42" from 368' to 748'.

6-20-62 Opened 26" hole to 42" from 748' to 855'. Cleaned tight hole. Hole filled in to 826', bit plugged working stuck pipe.

6-21-62 Ran inside of drill pipe with $1\frac{1}{4}$" tubing to 471' and blew drill pipe free of sand. Rig secured for 3 hours. Ran tubing on to bit and blew drill pipe clean. Pulled tubing and got normal returns. Worked pipe & it came free.

6-22-62 Cleaned out from 768' to 809'. Air drilling head blew off. Worked pipe out of tight hole, had to single out. Bit is plugged. Worked pipe up to 608'.

6-23-62 Worked pipe out of the hole. Ran in hole with 42" drilling assembly and cleaned out to 685'. Plugged bit. Pulled out of hole and cleaned bit. Ran in and cleaned out fill to 575' and plugged the bit. Pulled out, cleaned bit and re-ran same. Cleaned out to 687'.

6-24-62 Cleaned out to 855'. Opened hole to 42" from 855' to 869'. The above sloughing, trouble was attributed to bad water, and soap that was not compatible with water.

6-25-62 Opened hole from 869' to 875'. Pulled out and re-ran to check for fill. Cleaned out fill from 840' to 875'. Conditioned hole. Pulled out and re-ran, pipe stopped at 680'. Reamed tight hole from 670' to 875', 49' fill. Conditioned hole.

6-26-62 Made trio up to casing and ran back and found top of fill at 827' (48' fill). Cleaned out to 875' and opened 26" hole to 42" from 875' to 938'. Made round trip to check fill. Top of fill 718' to 857'.

6-27-62 Cleaned out fill from 857' to 939'. Rig secured for 6 hours. Ran in with 42" hole opening assembly and cleaned out fill from 923' to 939'. Blew hole clean. Started to run 29" casing.

6-28-62 Ran and cemented new 29" x 5/8" wall casing at 870', thru drill pipe stabbed into Baker float shoe with 5000 cu ft. of cement, pre-mixed with 2½% pre-hydrated gel, 15#/cu ft. of Gilsonite, 1% Halad 9 and 2% $CaCl_2$. Bumped ball at 600#, released pressure and ball held. Standing cemented.

6-29-62 Located top of cement at 670'. With open end tubing in the annulus at 670' pumped in 1000 cu ft. cement 1-1 perlite with 4% gel. Located top of cement at 656'. With open end tubing hung at 656' pumped in 1000 cu ft. of cement with 4% gel. Located top of cement at 605'. With open end tubing hung at 605' pumped in 1000 cu ft. of cement 1-1 perlite and 4% gel.

6-30-62 Located top of cement at 627'. With open end tubing hung at 609' pumped in 1000 cu ft. of cement 1-1 perlite and 4% gel. Located top of cement at 608'. With open end tubing hung at 577' pumped in 1000 cu ft. of cement 1-1 perlite and 4% gel. Located top of cement at 608'. With open end drill pipe hung at 528' pumped in 200 sxs Cal-Seal. Located top of Cal-Seal plug at 608'. With open end drill pipe hung at 451' pumped in 400 cu ft. slurry 1-1 Cal-Seal & cement with 20 cu ft. of gilsonite. Located top of plug at 625'. With open end tubing hung at 451' pumped in 1000 cu ft. of cement 1-2 perlite and 4% gel. Located top of cement at 615'.

7-1-62 With open end tubing hung at 500' pumped in 200 sxs Cal Seal. Located top of plug at 605'. With open end tubing hung at 500' pumped in 400 cu ft. cement 1-1 Cal-Seal with 20# cu ft. of gilsonite. With open end tubing hung at 500' pumped in 1000 cu ft. cement 1-1 perlite with 4% gel. Located top of cement at 598'. With open end tubing hung at 577' pumped in 50 bbls hydrogel with a catalyst followed by 70 bbls hydrogel with a catalyst followed by 200 cu ft. of cement. Landed 29" casing.

7-2-62 Laid down tubing. Ran in with 26½" bit, bit stopped at 862.36'. Came out of hole laying down drill pipe. Rigged down.

7-3-62 Moved out hole suspended.

7-4-62 No activity.

7-5-62 Moved in Portadrill rig. Ran 2 3/8" tubing in annulus and located top of plug at 587'. Pulled up to 551' and pumped in 500 cu ft. of cement 1-1 perlite with 4% gel and 2% $CaCl_2$. Located top of plug at 594'. With open end tubing hung at 531' pumped in 1000 cu ft. cement 1-1 perlite with 4% gel and 2% $CaCl_2$.

7-6-62 Located top of Cement at 571'. Rig secured 7 hours. Rig moved out @ 1230hours.

7-7-62 Thru 7-9-62 No activity.

7-10-62 Moved in National T-20 rig and rigged up to pump sand in the annulus. Located top of cement in annulus at 562'. Dumped in a total of 1280 cu. ft. of sand. Located top of sand at 519'.

7-11-62 Pulled up to 365' and pumped in 248 cu ft. of Cal Seal. Checked top of plug at 506'. Dumped in 2240 cu ft. sand. Located top of plug at 511'. Pumped in 200 sxs Cal-Seal. Located top of plug at 506'.

7-12-62 Dumped in 1320 cu ft. sand. Located top at 446'. Pumped in 200 sxs Cal-Seal followed by 1000 cu ft. cement 1-1 perlite with 4% gel & 2% $CaCl_2$. 1½ hours wait between jobs. Dumped 1600 cu ft. sand in annulus, located top at 437'. Moved out National T-20 rig and moved in AEC Failing 2500. Pumped in 1200 cu ft. perlite & 400 cu ft. of sand. Pumped in 1320 cu ft. perlite & 400 cu ft. sand.

7-13-62 Rig secured 3 hours. Pumped in 200 cu ft. cement with 1-1 Cal-Seal. Located top of cement at 424'. Pumped in 500 cu ft. cement 1-1 perlite with 4% gel. Checked top of plug at 422'.

7-14-62 Dumped in 800 cu ft. sand and located top at 415'. Pumped in 500 cu ft. cement 1-1 perl te with 4% gel and 2% $CaCl_2$. Located top of plug at 416'. Blew in 800 cu ft. sand. Checked bottom at 408'. Blew in 880 cu ft. of sand, checked plug at 402'.

7-15-62 Blew in 880 cu ft. of sand and gravel. Located top of plug at 401'. Pumped in 840 cu ft. of sand in hole. Located top of plug at 387'. Pumped in 210 cu ft. of sand with tubing hung at 305'.

7-16-62 Pumped in 810 cu ft. of sand with tubing hung at 305'. Checked top of plug at 297'. Pumped in 210 cu ft. sand with tubing hung at 275' and cemented with 500 cu ft. cement with 1-1 perlite, 4% gel and 2% $CaCl_2$. Checked top of plug at 285'. Cemented with 1000 cu ft. cement with 4% gel and 2% $CaCl_2$. Located top of plug at 173'. With tubing hung at 114' pumped in 1000 cu ft. of cement with 4% gel and 2% $CaCl_2$. Located top of plug at 145'. With tubing hung at 115' pumped in 1000 cu ft. cement 1-1 perlite with 4% gel and 2% $CaCl_2$. Checked fluid level in 29" casing at 407'. Located top of plug at 90' . Moved out rig.

7-17-62 Moved in Ideco H-35 and rigged up. Picked up 26" bit and checked top of cement in casing at 865.61'. With tubing hung at 60' in annulus pumped in 500 cu ft. cement 1-1 perlite. Located top of cement at 35'.

7-18-62 Pumped in 400 cu ft. of neat cement, annulus filled to surface. Ran Sperry Sun Gyroscopic Multishot survey from surface to 865'. Scraped 29" casing. Made mandrel run to 865.84'. Swabbed hole with tire swab. Laid down swab and bailed the hole.

7-19-62 Bailed hole and swabbed. Received orders to plug hole back. With open end drill pipe hung at 864' plugged 29" casing with 660 cu ft. cement with 2% HA-5. Located top of plug at 685'.

7-20-62 Ran in with 26" bit and drilled out cement to 720'. Scrapped 29" casing. Swabbed 29" casing.

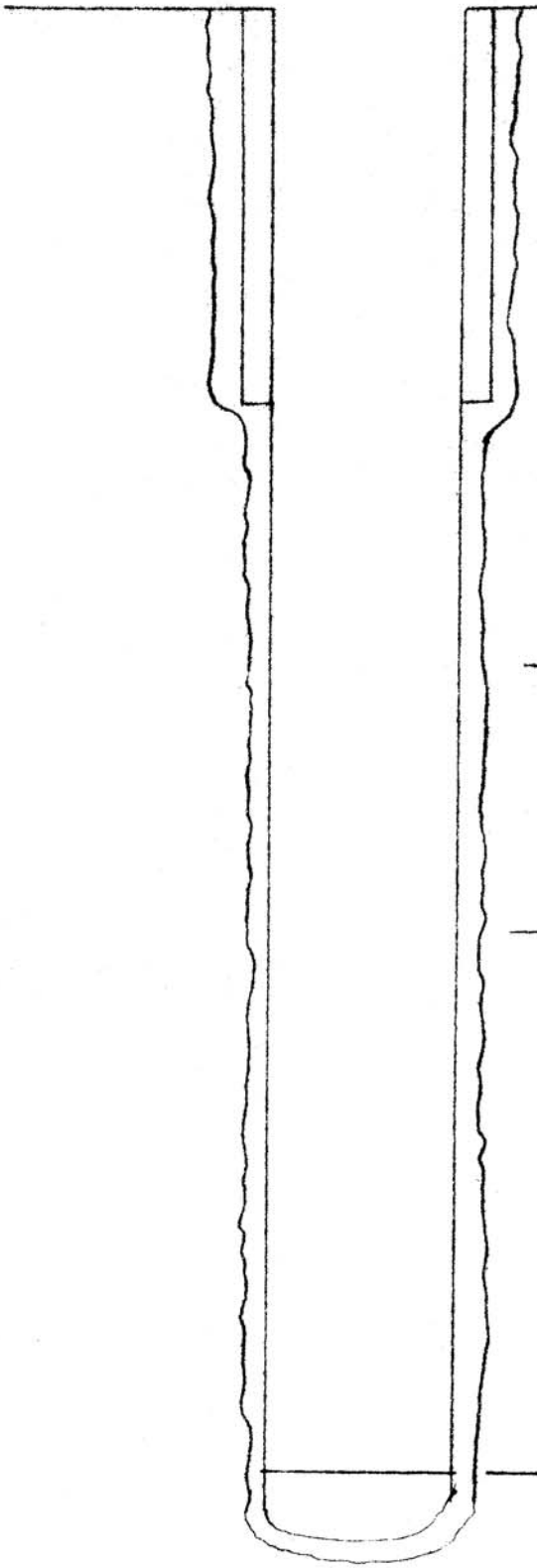
7-21-62 Bailed hole and ran dry swab. Measured in with 26½" mandrel to check working point, in and out 717.92'. Laid down drill pipe. Rigged down and moved out. Hole completed 7-21-62.

Emplacement HOLE

Stn. U-3bh

COORDINATES: N. 835,600.04 E. 688,400.65

ELEV. 4016.9



85'

64 " Diameter Hole

85'

53¼ " 352 # Casing Cemented to surface in 64 " Diameter Hole

939' 42 " Diameter Hole

870' 29 " 196 # Casing Cemented to Surface in 42 " Diameter Hole

717' Inside Total Depth

BOTTOM COORDINATES N. 835,599.93 E. 688,399.55

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3bg

WORK ORDER NUMBER 1215-20 H & N I.D. NUMBER 182720 E.D.S. NUMBER

USER LASL TYPE HOLE Emplacement

LOCATION: Nevada - NTS County Nye Area 3

Coordinates N836,399.68 E688,400.45 Surface Elevation 4021.9

RIG SCHEDULE: MOVED ON LOCATION 5-28-62 SPUDDED 5-29-62 COMPLETED 6-20-62

REMARKS: Hole idle from 6-15-62 to 6-19-62 Incl. USER ACCEPTANCE 6-20-62

MUD PROGRAM: Air

DRILLING EQUIPMENT Oilwell 860 thru pumping out stage. National T-20 to complete.

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	80'	60"	54"	352#		B W	0'	80'	650 cu ft.
80'	875'	42"	29"	198#	J-55	B W	0'	871'	9555 cu ft
875'	1080'	26"							

TOTAL DEPTH 1080' WORKING POINT 865.04' PLUGS 1080' - 875'

JUNK None

LOGGING DATA Lane Wells temperature survey to 865'. Sperry Sun gyroscopic multishot directional survey from surface to 868'.

DEVIATION DATA: M.D. 865' V.D. 865' REFERENCE SUR 358

BOTTOM HOLE COORDINATES @ 865' N836,400.91, E688,400.16

CORING HISTORY None taken.

Well History
Sta. U-3bg

5-26-62 Moved in bucket rig and drilled 60" hole to 80'.

5-27-62 Ran and cemented 54" casing at 80' with 650 cu ft. cement with 2% $CaCl_2$.

5-28-62 Moved in Oilwell 860 and rigged up.

5-29-62 Completed rigging up. Drilled out shoe with center punched set and made 15" hole to 86' using air as a circulating media.

5-30-62 Drilled 15" hole from 86' to 148'.

5-31-62 Drilled 15" hole from 148' to 690'.

6-1-62 Drilled 15" hole from 690' to 1080'. Opened 15" hole to 26" from 80' to 305'.

6-2-62 Opened 15" hole to 26" from 305' to 1080'.

6-3-62 Opened 26" hole to 42" from 80' to 750'.

6-4-62 Opened 26" hole to 42" from 750' to 875'. Ran in with 15" bit and it stopped at 876'. Ran in 42" drilling assembly and found 37' of fill (838'). Pulled out and re-ran same assembly in 4 hours to check fill, found 50' (825'). Cleaned out fill to 875' and blew hole clean.

6-5-62 Checked fill after 4 hours, found 1' (874'). Rechecked fill after 8 hours, no fill.

6-6-62 Rig secured 5 hours. Checked fill, bit went to 875'. Started to run 29" casing.

6-7-62 Ran and cemented new 29" I.D. x 5/8" wall casing at 870.87' , thru drill pipe stabbed into Baker float shoe with 4100 cu ft. of cement pre-treated with 15# cu ft. gilsonite, 2% pre-hydrated gel, 1% Halad 9 and 2% $CaCl_2$.

6-8-62 Stood cemented 8 hours. Ran Lane Wells Temperature log and located top of cement at 400'. Ran tubing in the annulus to 400' and pumped in 1000 cu ft. of cement 1-1 perlite and 2% $CaCl_2$. Ran Sperry Sun Gyroscopic survey from surface to 865'. Located top of cement at 225' with open end tubing hung at 210' pumped in 1000 cu ft. of cement 1-1 perlite and 2% $CaCl_2$. With open end tubing hung at 200' pumped in 1000 cu ft. of cement 1-1 perlite with 2% $CaCl_2$. With open end drill pipe hung at 150' pumped in 1000 cu ft. cement 1-1 perlite and 2% $CaCl_2$.

6-9-62 With open end tubing hung at 90' pumped in 1000 cu ft. cement 1-1 perlite and 2% $CaCl_2$. With open end tubing hung at 42' pumped in 455 cu ft. neat cement. Cement to surface. Used total of 9555 cu ft.

6-10-62 Ran in with 26½" mandrel to 864'. Repaired draw works.

6-11-62 Repairing draw works.

6-12-62 Repairing draw works.

6-13-62 Repairing draw works.

6-14-62 Ran B-J submersible pump and pumped fluid out of hole. Tore out and moved rig.

6-15-62 Thru 6-19-62 No activity.

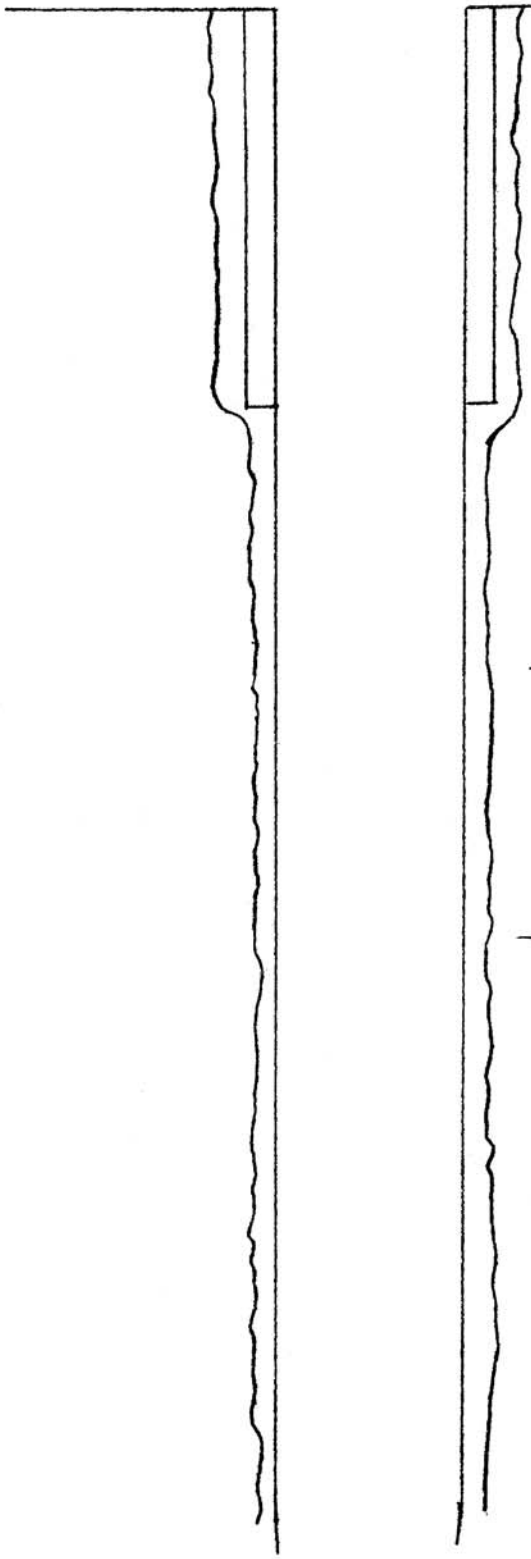
6-20-62 Moved in National T-20 rig. Bailed hole dry. Ran 26½" mandrel and established working point of 865.04'. Laid down drill pipe and moved out. Well completed 9-20-62.

Emplacement HOLE

U-3bg

COORDINATES: N. 836,399.68 E. 688,400.45

ELEV. 4021.9



80' 60 " Diameter Hole

80' 54 " 352 # Casing Cemented to surface in 60 " Diameter Hole

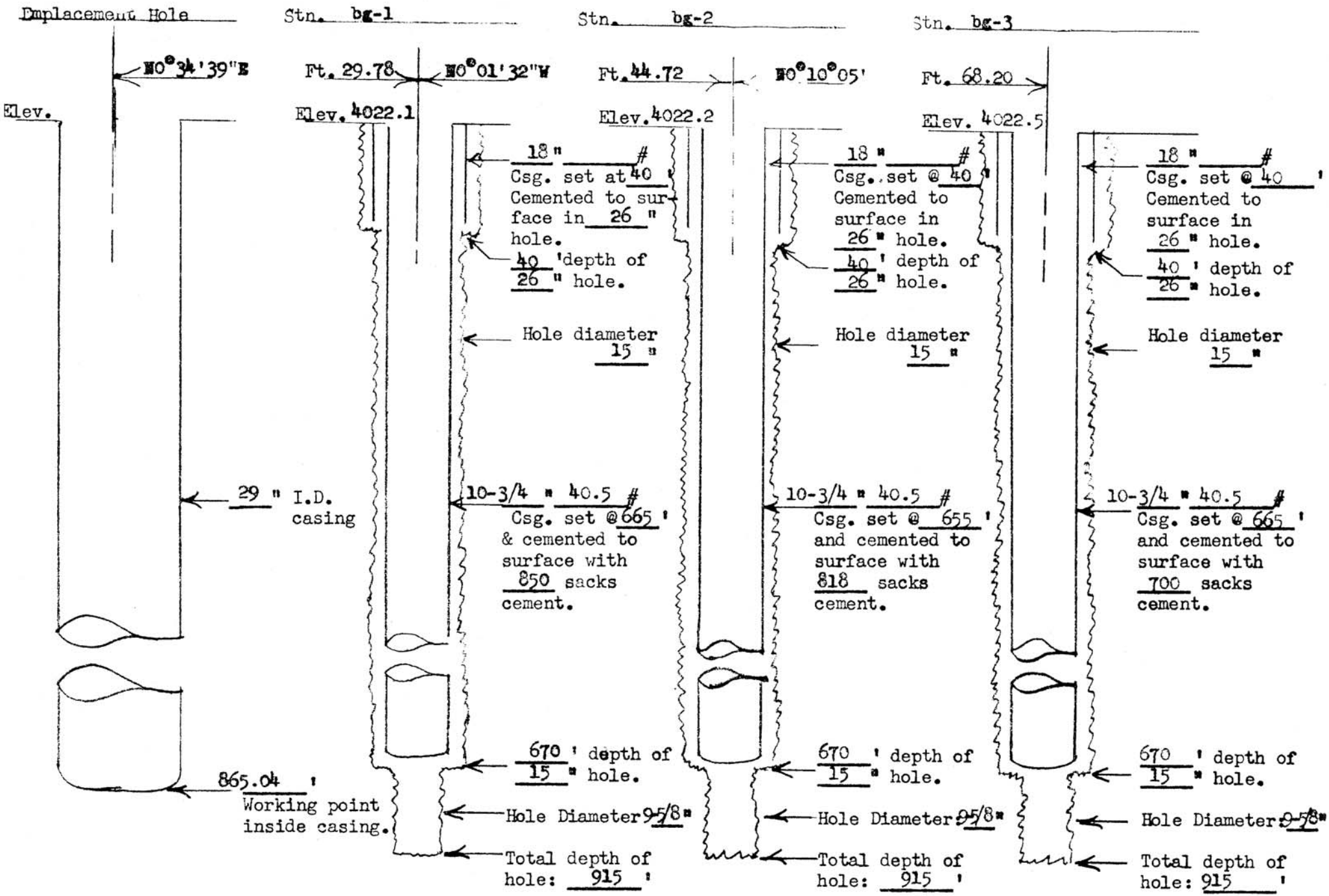
875' 42 " Diameter Hole

871' 29 " 198 # Casing Cemented to Surface in 42 " Diameter Hole

Bottom 42" hole 875'. Hole plugged with sand 875' to 1080'. 29" hole from 875' to TD of 1080'.

BOTTOM COORDINATES N. 836,400.91 E. 688,400.16

U-3-bg



ARR
4-17-62

Appendix B

Construction information for all holes drilled within the RWMS

Note: The satellite holes were drilled prior to the event for installation of instrumentation and backfilled with sand to approximately 30 m from the surface and cemented from there to the surface. Post-shot holes were drilled to obtain samples for radiochemical analyses. There are no records of how the vertically-drilled post-shot holes were left, but it was common practice to just install a welded cap, blind flange or slide valve on the top of the surface casing and not backfill these holes drilled within the surface collapse crater holes. PrePost-shot holes were started with a surface casing but not used.

Holes Within 70 Meters of Station U3ax

Hole	Dist (m)	Bearing	Hole Type	Hole Diameter (m)	Casing (m)	Depth (m)	Elevation (m)
U3ax	0		Emplacement	0.737	FC	261	1226
U3ax-1	5	N4W	Satellite	0.244	PC	279	1226
U3ax-PS-1	5	S27W	Post-shot	0.244	UC	297	1213
U3ax-PS-1S	6	S6E	Post-shot	0.244	UC	288	1213
U3ax-PS-2	6	N25E	Post-shot	0.244	UC	297	1212
U3ax-2	8	N2W	Satellite	0.244	PC	279	1226
U3ax-3	12	N2W	Satellite	0.244	PC	279	1226
U3ax-4	15	S60E	Satellite	0.737	FC	10	1226
U3ax-PS-6	96	N75E	Post-shot	0.159	UC	331	1226
U3ax-PPS-5	96	DUE E	PrePost-shot	0.273	FC	12	1226
U3ax-PPS-4	96	DUE S	PrePost-shot	0.273	FC	12	1225
U3ax-PPS-3	96	S80W	PrePost-shot	0.273	FC	12	1225

FC = fully cased
PC = partially cased
UC = uncased (surface conductor only)

Holes Within 61 Meters of Station U3bl

Hole	Dist (m)	Bearing	Hole Type	Hole Diameter (m)	Casing (m)	Depth (m)	Elevation (m)
U3bl	0		Emplacement	0.914	FC	208	1226
U3bl-PS-1	5	N65W	Post-shot	0.244	UC	234	1216
U3bl-PS-2	5	N65E	Post-shot	0.244	UC	236	1216
U3bl-1	8	N2E	Satellite	0.244	PC	219	1226
U3bl-2	11	N2W	Satellite	0.244	PC	219	1226
U3bl-3	16	DUE N	Satellite	0.244	PC	219	1226
U3bl-3S	17	N85E	Satellite	0.244	PC	235	1226
U3ax-PPS-5	47	N11W	PrePost-shot	0.273	FC	12	1226
U3ax-PS-6	72	N10W	Post-shot	0.159	UC	331	1226
U3ax-PS-1S	111	N69W	Post-shot	0.244	UC	288	1213
U3ax-PS-2	114	N63W	Post-shot	0.244	UC	297	1212
U3ax-PS-1	114	N69W	Post-shot	0.244	UC	297	1213
U3ax-PPS-4	116	S64W	PrePost-shot	0.273	FC	12	1225
U3ax-PPS-3	201	N82W	PrePost-shot	0.273	FC	12	1225

FC = fully cased
PC = partially cased
UC = uncased (surface conductor only)

Holes Within 85 Meters of Station U3at

Hole	Dist (m)	Bearing	Hole Type	Hole Diameter (m)	Casing (m)	Depth (m)	Elevation (m)
U3at	0		Emplacement	0.737	FC	305	1224
U3at-PS-1	6	DUE S	Post-shot	0.229	UC	336	1199
U3at-PS-2	6	DUE N	Post-shot	0.229	UC	302	1199
U3at-1	8	DUE N	Satellite	0.244	PC	322	1224
U3at-2	12	DUE N	Satellite	0.244	PC	326	1224
U3at-3	18	DUE N	Satellite	0.273	PC	190	1224
U3at-3S	20	DUE N	Satellite	0.244	PC	320	1224
U3at-PS-3	130	DUE W	Post-shot	0.156	UC	383	1224

FC = fully cased
PC = partially cased
UC = uncased (surface conductor only)

Holes Within 80 Meters of Station U3az

Hole	Dist (m)	Bearing	Hole Type	Hole Diameter (m)	Casing (m)	Depth (m)	Elevation (m)
U3az	0		Emplacement	0.737	FC	264	1224
U3az-PS-2	4	N70W	Post-shot	0.244	UC	278	1198
U3az-PS-1	4	S86E	Post-shot	0.244	UC	284	1198
U3az-1	5	DUE N	Satellite	0.244	PC	279	1224
U3az-2	8	N2E	Satellite	0.244	PC	279	1224
U3az-3	12	N1E	Satellite	0.381	PC	207	1224
U3az-3S	16	DUE N	Satellite	0.244	PC	279	1224

FC = fully cased
PC = partially cased
UC = uncased (surface conductor only)

Holes Within 89 Meters of Station U3ah

Hole	Dist (m)	Bearing	Hole Type	Hole Diameter (m)	Casing (m)	Depth (m)	Elevation (m)
U3ah	0		Emplacement	0.610	FC	366	1225
U3ah-PS-1	4	N12E	Post-shot	0.197	PC	326	1210
U3ah-PS-1S	4	N12E	Post-shot	0.197	PC	396	1210
U3ah-PS-2	5	S21W	Post-shot	0.229	PC	411	1210
U3ah-1	8	N5W	Satellite	0.197	PC	385	1226
U3ah-2	18	N6W	Satellite	0.197	PC	384	1226
U3ah-3	30	N6W	Satellite	0.197	PC	384	1226

FC = fully cased
PC = partially cased
UC = uncased (surface conductor only)

Holes Within 79 Meters of Station U3bg

Hole	Dist (m)	Bearing	Hole Type	Hole Diameter (m)	Casing (m)	Depth (m)	Elevation (m)
U3bg	0		Emplacement	0.737	FC	264	1226
U3bg-PS-2	6	N49W	Post-shot	0.244	UC	300	1207
U3bg-PS-1	6	DUE S	Post-shot	0.244	UC	297	1207
U3bg-1	9	N2E	Satellite	0.244	PC	279	1226
U3bg-2	13	DUE N	Satellite	0.244	PC	279	1226
U3bg-3	21	DUE N	Satellite	0.244	PC	279	1226
U3bg-PS-3	106	DUE W	Satellite	0.095	PC	22	1226

FC = fully cased
PC = partially cased
UC = uncased (surface conductor only)

Holes Within 78 Meters of Station U3bh

Hole	Dist (m)	Bearing	Hole Type	Hole Diameter (m)	Casing (m)	Depth (m)	Elevation (m)
U3bh	0		Emplacement	0.737	FC	219	1224
U3bh-PS-1	3	N5W	Post-shot	0.244	UC	233	1203
U3bh-PS-2	5	S48E	Post-shot	0.244	UC	243	1203
U3bh-PS-1S	5	N18W	Post-shot	0.244	UC	231	1203
U3bh-PS-1SS	5	N18W	Post-shot	0.244	UC	230	1203
U3bh-1	9	N2E	Satellite	0.457	FC	12	1224
U3bh-2	14	N1E	Satellite	0.457	FC	12	1224
U3bh-3	27	N1E	Satellite	0.457	FC	12	1224

FC = fully cased
PC = partially cased
UC = uncased (surface conductor only)

Appendix C

Boreholes measurements made in the RWMS emplacement holes

Note: See Table 7 for explanation of log abbreviations.

Hole U3az

log	logger	depth interval
CVL	Lane Wells	680. to 878.
DENSITY	Lane Wells	680. to 881.
DIR GYRO	Sperry Sun	0. to 865.
ELOG	Lane Wells	680. to 881.
ELOG FOCUS	Lane Wells	680. to 874.
ELOG IND	Lane Wells	680. to 882.
GR-N	Lane Wells	680. to 881.
TEMP	Lane Wells	30. to 867.
CALIPER	Lane Wells	38. to 714.
DIR GYRO	Sperry Sun	0. to 909.
CALIPER	Lane Wells	50. to 711.
DIR GYRO	Serry Sun	0. to 920.
CALIPER	Lane Wells	50. to 714.
DIR GYRO	Sperry Sun	0. to 910.
DIR GYRO	Sperry Sun	0. to 932.
GAMMA HINT	Lane Wells	700. to 931.
GAMMA HINT	Lane Wells	100. to 931.
TEMP	Lane Wells	700. to 931.
TEMP	Lane Wells	100. to 931.
DIR MAG	Sperry Sun	0. to 913.
GAMMA HINT	Lane Wells	300. to 879.

Hole U3bg

log	logger	depth interval
DIR GYRO	Sperry Sun	0. to 865.
TEMP	Lane Wells	100. to 868.
DIR GYRO	Sperry Sun	0. to 915.
DIR GYRO	Sperry Sun	0. to 916.
DIR GYRO	Sperry Sun	0. to 917.
DIR MAG	Sperry Sun	0. to 965.
GAMMA HINT	Lane Wells	680. to 960.
DIR MAG	Sperry Sun	0. to 925.

Hole U3bh

log	logger	depth interval
DIR GYRO	Sperry Sun	0. to 865.
DIR MAG	Sperry Sun	50. to 756.
GAMMA HINT	Lane Wells	550. to 743.
DIR MAG	Sperry Sun	0. to 695.
GAMMA HINT	Lane Wells	500. to 750.

Well Logs from Area 3 Radiation Waste Management Site
(U3ax, U3bl, U3ah, U3at, U3az, U3bg, and U3bh)

Hole U3ax

log	logger	depth interval
CVL	Lane Wells	600. to 874.
DIR GYRO	Sperry Sun	0. to 850.
ELOG	Lane Wells	600. to 777.
ELOG FOCUS	Lane Wells	600. to 878.
ELOG IND	Lane Wells	600. to 877.
GR-N	Lane Wells	700. to 877.
TEMP	Lane Wells	700. to 877.
CALIPER	Lane Wells	30. to 809.
DIR GYRO	Sperry Sun	0. to 915.
CALIPER	Lane Wells	0. to 800.
DIR GYRO	Sperry Sun	0. to 915.
CALIPER	Lane Wells	63. to 801.
DIR GYRO	Sperry Sun	0. to 915.
DIR MAG	Sperry Sun	0. to 915.
GAMMA	Lane Wells	770. to 939.
DIR MAG	Sperry Sun	0. to 900.
GAMMA	Lane Wells	750. to 920.
DIR MAG	Sperry Sun	0. to 808.
GAMMA	Lane Wells	300. to 943.
DIR GYRO	Sperry Sun	40. to 1086.
GR-N	Lane Wells	800. to 1084.
TEMP	Lane Wells	820. to 1040.

Hole U3bl

log	logger	depth interval
DIR GYRO	Sperry Sun	0. to 682.
DIR GYRO	Sperry Sun	0. to 707.
DIR GYRO	Sperry Sun	0. to 725.
DIR GYRO	Sperry Sun	0. to 500.
DIR MAG	Sperry Sun	0. to 715.
DIR MAG	Sperry Sun	0. to 765.
GAMMA HINT	Lane Wells	550. to 690.
GAMMA HINT	Lane Wells	550. to 767.
TEMP	Lane Wells	0. to 768.
DIR MAG	Sperry Sun	0. to 770.
GAMMA HINT	Lane Wells	620. to 772.
TEMP	Lane Wells	0. to 773.

Hole U3ah

log	logger	depth interval
CVL	Schlumberger	90. to 1197.
DIR GYRO	Sperry Sun	0. to 1200.
ELOG	Schlumberger	90. to 1198.

GR-N	Schlumberger	90. to 1200.
TEMP	Schlumberger	0. to 1200.
CALIPER	Lane Wells	100. to 1101.
CALIPER	Lane Wells	1100. to 1259.
CVL	Lane Wells	100. to 1098.
CVL	Lane Wells	1100. to 1258.
DIR GYRO	Sperry Sun	0. to 1260.
ELOG IND	Lane Wells	63. to 1041.
ELOG IND	Lane Wells	1040. to 1101.
ELOG IND	Lane Wells	1100. to 1261.
GR-N	Lane Wells	100. to 1101.
GR-N	Lane Wells	1100. to 1261.
CALIPER	Schlumberger	10. to 1075.
CALIPER	Lane Wells	1075. to 1260.
CVL	Schlumberger	20. to 1073.
CVL	Lane Wells	1075. to 1260.
DIR GYRO	Sperry Sun	0. to 1260.
ELOG	Schlumberger	50. to 1075.
ELOG IND	Lane Wells	1075. to 1260.
ELOG IND	Schlumberger	9. to 1070.
ELOG MINI	Schlumberger	10. to 1075.
GR-N	Lane Wells	930. to 1260.
GR-N	Schlumberger	0. to 1075.
TEMP	Schlumberger	0. to 1077.
CALIPER	Lane Wells	130. to 1060.
CALIPER	Lane Wells	1060. to 1259.
CVL	Lane Wells	170. to 1058.
CVL	Lane Wells	1058. to 1258.
DIR GYRO	Sperry Sun	0. to 1260.
ELOG IND	Lane Wells	170. to 1061.
ELOG IND	Lane Wells	1060. to 1259.
GR-N	Lane Wells	70. to 1061.
GR-N	Lane Wells	1060. to 1259.
CALIPER	Lane Wells	50. to 1098.
CALIPER	Lane Wells	1100. to 1217.
CVL	Lane Wells	50. to 1098.
CVL	Lane Wells	1100. to 1213.
ELOG IND	Lane Wells	50. to 1101.
ELOG IND	Lane Wells	1100. to 1216.
GR-N	Lane Wells	30. to 1101.
GR-N	Lane Wells	1100. to 1216.
TEMP	Lane Wells	50. to 1217.
CALIPER	Lane Wells	56. to 1093.
CALIPER	Lane Wells	1103. to 1213.
CVL	Lane Wells	1102. to 1212.
DENSITY	Lane Wells	1103. to 1214.
DIR GYRO	Sperry Sun	0. to 1215.
ELOG	Lane Wells	1102. to 1215.
ELOG FOCUS	Lane Wells	1103. to 1215.
ELOG IND	Lane Wells	1102. to 1215.
GR-N	Lane Wells	60. to 1215.
TEMP	Lane Wells	20. to 1216.
CALIPER	Lane Wells	30. to 1095.
CALIPER	Lane Wells	1095. to 1213.

CVL	Lane Wells	0. to 1094.
CVL	Lane Wells	1095. to 1212.
DIR GYRO	Sperry Sun	0. to 1215.
ELOG IND	Lane Wells	0. to 1088.
ELOG IND	Lane Wells	1095. to 1215.
GR-N	Lane Wells	0. to 1088.
GR-N	Lane Wells	1095. to 1215.
TEMP	Lane Wells	620. to 1210.
CALIPER	Lane Wells	65. to 1098.
CALIPER	Lane Wells	1100. to 1213.
CVL	Lane Wells	1100. to 1212.
DENSITY	Lane Wells	1100. to 1216.
DIR GYRO	Sperry Sun	0. to 1215.
ELOG	Lane Wells	1100. to 1216.
ELOG FOCUS	Lane Wells	1100. to 1216.
ELOG IND	Lane Wells	1100. to 1215.
GR-N	Lane Wells	70. to 1215.
TEMP	Lane Wells	40. to 1216.
DIR GYRO	Sperry Sun	0. to 1000.
DIR GYRO	Sperry Sun	0. to 1300.
TEMP	Lane Wells	800. to 1298.
GAMMA	Lane Wells	990. to 1350.
GAMMA	Lane Wells	960. to 1263.
TEMP	Lane Wells	940. to 1264.
TEMP	Lane Wells	990. to 1350.

Hole U3at

log	logger	depth interval
CVL	Lane Wells	600. to 876.
CVL	Lane Wells	800. to 1011.
DIR GYRO	Sperry Sun	0. to 1000.
DIR GYRO	Lane Wells	0. to 1000.
ELOG	Lane Wells	500. to 876.
ELOG	Lane Wells	800. to 1014.
ELOG FOCUS	Lane Wells	600. to 770.
ELOG FOCUS	Lane Wells	800. to 1008.
ELOG IND	Lane Wells	600. to 876.
ELOG IND	Lane Wells	600. to 1014.
GR-N	Lane Wells	650. to 876.
GR-N	Lane Wells	800, to 1014.
TEMP	Lane Wells	540. to 876.
TEMP	Lane Wells	800. to 1013.
DIR GYRO	Sperry Sun	0. to 1061.
CALIPER	Lane Wells	0. to 627.
DIR GYRO	Sperry Sun	0. to 1069.
CALIPER	Lane Wells	20. to 618.
DIR GYRO	Sperry Sun	0. to 1050.
DIR GYRO	Sperry Sun	0. to 1059.
GAMMA HINT	Lane Wells	880. to 1085.
DIR MAG	Sperry Sun	0. to 1206.
DIR MAG	Sperry Sun	0. to 175.
GAMMA HINT	Lane Wells	1000. to 1253.

Appendix D

Hole Histories for Holes Drilled for the U3ax Event

U-3ax-1
U-3ax-2
U-3ax-3
U-3ax PS #2
U-3ax PS #1
U-3ax PS #1S
U-3ax PS #6

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax-1

WORK ORDER NUMBER 1225-09 H & N I.D. NUMBER 182436 E.D.S. NUMBER M-326

USER LASL TYPE HOLE Sandia Diagnostic Instrument Hole

LOCATION: NTS(Nevada) County Nye Area 3

Coordinates N836,566.36 E 687,257.10 Surface Elevation 4020.71 ground 4022.86 Collar

RIG SCHEDULE: MOVED ON LOCATION 12-16-61 SPUDDED 12-19-61 COMPLETED 4-7-62

REMARKS: USER ACCEPTANCE 4-7-62

MUD PROGRAM: Low water loss mud wt. 73, W.L. 1.8 vix. 52, P.H. 9, Sand Content 4.5

Air 815' to 915' (no record total bbls mud used)

DRILLING EQUIPMENT Pacific #4 Ideco H-30 (0 to 815')

Lohmann # 25 (Franks Mod. # 658) (815' to 915')

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0	60	26"	20"	32#	Conductor Pipe		0	60	100
60	815'	15"	10-3/4"	40.5	J-55	T&C	0	813	596
815	924'	9-5/8"							

TOTAL DEPTH 924' WORKING POINT 924' PLUGS None

JUNK None

LOGGING DATA Lane Wells Caliper 60' to 815' - Sperry Sun survey to 915'.

DEVIATION DATA: M.D. 924' V.D. 924' REFERENCE Sur 247 (6.LO

BOTTOM HOLE COORDINATES N836,571.53 E687,251.41 (7.69' @ N 47° 45'W)

CORING HISTORY No cores taken

WELL HISTORY
U-3ax-1

12/16/61 Moving rig to location.

12/17/61 Moving rig to location.

12/18/61 Rigging up.

12/19/61 Completed rigging up, spudded and drilled 26" hole to 60'.
Ran 20" casing to 60' and waited on cementers.

12/20/61 Cemented 20" casing @ 60' with 110 cu. ft. cement. Cement returned to surface. Drilled 15" hole from 60' to 263'.

12/21/61 Drilled 15" hole from 263' to 491'.

12/22/61 Drilled 15" hole from 491' to 705'.

12/23/61 Drilled 15" hole from 705' to 730'. Secured rig.

12/24/61 Secured rig.

12/25/61 Secured rig.

12/26/61 Secured rig to 11:30. Drilled 15" hole from 730' to 783'.

12/27/61 Drilled 15" hole from 783' to 815'. Ran Lane Wells Caliper log.
Ran 10-3/4" casing with shoe @ 813' and cemented 900 cu. ft. of cement with 2% gel and 2% CaCl.
Cut off casing and rigged down.

12/28/61 Moved rig off and suspended hole.

12/28/61 to 4/6/62 Hole suspended.

4/6/62 Moved in, rigged up.

4/7/62 Blew water out of hole and drilled cement with 9-5/8" bit.
Drilled 9-5/8" hole to 915'. Ran Sperry Sun survey.
Rigged down, moved off, hole completed.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax-2

WORK ORDER NUMBER 1225-09 H & N I.D. NUMBER 182436 E.D.S. NUMBER M-508

USER LASL TYPE HOLE Sandia Diagnostic Hole

LOCATION: NTS (Nevada) County NYE Area 3

Coordinates N836,575.26 E.687,257.31 Surface Elevation 4022.69 Collar 4020.6 ground

RIG SCHEDULE: MOVED ON LOCATION 12-29-61 SPUDDED 12-29-61 COMPLETED 4-9-62

REMARKS: Hole Suspended 1-7-62 to 4-8-62 USER ACCEPTANCE 4-9-62

MUD PROGRAM: Low water loss mud wt. 74 Visc. 62, W.L. 1.5 sand content5%.

Air 814 to 915 (No record total bbls. mud used)

DRILLING EQUIPMENT Pacific 4 (Ideco H-30) 0. to 814'

Lohmann #25 (Franks Mod #658) 814' to 915'.

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0	50'	26"	20	32#	Conductor Pipe		0	50	85
50	814'	15"	10-3/4"	40.5#	J-55	T&C	0	814'	875
814'	915'	9-5/8"							

TOTAL DEPTH 915' WORKING POINT 915' PLUGS none

JUNK None

LOGGING DATA Lane Wells Caliper Log 50' to 814', Sperry Sun directional Survey (0-915')

DEVIATION DATA: M.D. 915 V.D. 915 REFERENCE Sur 252

BOTTOM HOLE COORDINATES N836,574.52 E.687,254.30 (3.10' @ S76°11'w)

CORING HISTORY No cores taken

WELL HISTORY
U-3ax-2

12/29/61	Moved in, rigged up, spudded and drilled 26" hole to 50'. Ran 60' of 20" casing 32# and set at 50'.
12/30/61	Cemented 20" with 100 cu. ft. with 2% gel and 2% $CaCl_2$. Drilled 15" hole from 50' to 188'. Secured rig at 2100 for AEC.
12/30/61 to 1-2-62	Rig secured by AEC from 12-30-61 to 1-2-62. Rig secured to 0800.
1/2/62	Started up and drilled 15" hole from 188' to 317'.
1/3/62	Drilled 15" hole from 317' to 515'.
1/4/62	Drilled 15" hole from 515' to 691'.
1/5/62	Drilled 15" hole from 691' to 814'. Ran Lane Wells Caliper Log (50' to 814'). Rigged up and started running casing.
1/6/62	Ran 10-3/4" casing 40.5# and set shoe at 814'. Cemented casing with 1000 cu. ft. cement using 2% Gel and 2% $CaCl_2$. Cut off casing, rigged down, moved rig off.
	Hole suspended from 1/7/62 to 4/8/62.
4/9/62	Rigged up, blew hole dry and drilled cement and shoe with 9-5/8" bit. Drilled 9-5/8" hole from 814' to 915'. Ran Sperry Sun directional survey (0-915') Rigged down, moved off, hole completed.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax-3

WORK ORDER NUMBER 1225-09 H & N I.D. NUMBER 182436 E.D.S. NUMBER M-508

USER LASL TYPE HOLE Sandia Diagnostic Hole

LOCATION: Nevada (NTS) County Nye Area 3

Coordinates N836,587.86 E687,257.10 Surface Elevation 4023.21 Collar, 4021.1 G.L.

RIG SCHEDULE: MOVED ON LOCATION 12-19-61 SPUDDED 12-19-61 COMPLETED 4-11-62

REMARKS: Hole suspended, 12-23-61 to 12-26-61.
Hole suspended, 12-28-61 to 4-10-62. USER ACCEPTANCE 4-11-62

MUD PROGRAM: Low water loss mud. (No record total bbls. mud used.)
Air, 801' to 915'.

DRILLING EQUIPMENT Terminal 5 (Ideco H-40) Used from 0' to 801'.
Lohmann #25 (Franks Model 3 Explorer) Used from 801' to 915'.

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	63'	26"	20"	32#	conductor pipe		0'	63'	110 cu. ft.
63'	801'	15"	10-3/4"	40.5#	J-55	T&C	0'	799'	875 cu. ft
801'	915'	9-5/8"							

TOTAL DEPTH 915' WORKING POINT 915' PLUGS None

JUNK None

LOGGING DATA Lane Wells caliper log (63'-801')
Sperry Sun directional survey (0'-915')

DEVIATION DATA: M.D. 915' V.D. 915' REFERENCE SUR 257 (G.L.)

BOTTOM HOLE COORDINATES N836,591.28 E687,260.38 (4.74' @ N43°48'E)

CORING HISTORY No cores taken.

WELL HISTORY
U-3ax-3

12-19-61	Moved in. Rigged up and spudded. Drilled 26" hole to 63'. Ran 70' of 20" casing and set at 63'.
12-20-61	Cemented 20" casing at 63' with 110 cu. ft. cement. Waited on cement 6½ hours. Drilled 15" hole from 63' to 236'.
12-21-61	Drilled 15" hole from 236' to 477'.
12-22-61	Drilled 15" hole from 477' to 712'.
12-23-61	Drilled 15" hole from 712' to 749'. Secured rig at 0600 hours.
12-24-61 thru 12-25-61	Rig secured.
12-26-61	Rig secured to 0800 hours. Started up and drilled 15" hole from 749' to 801'.
12-27-61	Ran Lane Wells caliper log from 63' to 801'. Ran 10-3/4" casing, shoe at 799' and cemented with 875 cu. ft. cement (2% gel and 2% $CaCl_2$).
12-28-61 thru 4-9-62	Well suspended.
4-10-62	Rigged up and drilled cement and shoe. Drilled 9-5/8" hole to 915' with air.
4-11-62	Ran Sperry Sun survey. Rigged down. Moved off. Hole completed, 4-11-62.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax PS # 2

WORK ORDER NUMBER 1213-86 H & N I.D. NUMBER 182084 E.D.S. NUMBER M-508

USER LASL TYPE HOLE Post Shot

LOCATION: NTS (Nevada) County Nye Area 3

Coordinates N836,568.59 E687,267.19 Surface Elevation 3978.4 Grnd., 3978.12 Csg.

RIG SCHEDULE: MOVED ON LOCATION 5-8-62 SPUDDED 5-8-62 COMPLETED 5-9-62

REMARKS: USER ACCEPTANCE ---

MUD PROGRAM: Plant mud, gel base, 58 to 68 sec. 72# Driscose and Soda Ash added.
Total mud used - 4295 bbls.

DRILLING EQUIPMENT Carmack (National D-300)

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0	40'	24"	10-3/4"	40.5	J-5	ST&C	0	40	170
40'	975'	9-5/8"							Gyp Seal

TOTAL DEPTH 975' WORKING POINT --- PLUGS None

JUNK None

LOGGING DATA Lane Wells gamma probe 300' to 880'. Sperry Sun magnetic multishot Survey 0' to 808'.

DEVIATION DATA: M.D. 808.00' V.D. 808.00' REFERENCE MS-309

BOTTOM HOLE COORDINATES N836,564.91 E 687,260.65 (7.50' @ S 60° 38'W)

CORING HISTORY Homco sidewall cores. 23 cores in the interval 847' to 910'.

DRILLING HISTORY
U-3ax PS #2

5/7/62 — 24" hole was drilled to 40' with a bucket rig.

5/8/62 — 10-3/4" O.D. 40.5# casing was cemented at 40' with 170 sacks of Gyp-Seal. Drilling equipment (Carmack) was moved in and 9-5/8" hole was drilled to 805'. Circulation was lost while drilling at 540'.

5/9/62 — 9-5/8" hole was drilled to a total depth of 975'.
Lane Wells gamma probe was run from 300' to 880'.
Homco sidewall coring tool was run and 23 samples were taken in the interval 847' to 910'. Sperry Sun magnetic multishot survey was run from 0' to 808'. Drilling equipment was moved out.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax PS # 1

WORK ORDER NUMBER 1213-86 H & N I.D. NUMBER 182084 E.D.S. NUMBER M-510

USER LASL TYPE HOLE Post Shot

LOCATION: NTS (Nevada) County Nye Area 3

Coordinates N836,533.57 E 687,250.09 Surface Elevation 3978.5 Grnd. 3979.34 Collar

RIG SCHEDULE: MOVED ON LOCATION 5/8/62 SPUDDED 5/8/62 COMPLETED 5/16/62

REMARKS: USER ACCEPTANCE —

MUD PROGRAM: Plant mud/ gel base, 60 to 68 sec. 72#, with Driscose and Soda Ash added. Total mud used 5225 bbls.

DRILLING EQUIPMENT Terminal #10 (Ideco H-35)

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0	40'	24"	10-3/4"	40.5	J-5	ST&C	0	40'	134 Cal-Seal
40'	975'	9-5/8"							

TOTAL DEPTH 975' WORKING POINT — PLUGS None

JUNK None

LOGGING DATA Lane Wells gamma probe 770' to 939'. Sperry Sun magnetic multishot 0' to 915'.

DEVIATION DATA: M.D. 915'.00 V.D. 914.92' REFERENCE MS-328

BOTTOM HOLE COORDINATES N836,523.81 E 687,239.44 (14.45 @ S 47° 30'W)

CORING HISTORY Homco sidewall cores. Total of 10 samples between 880' and 898'.

DRILLING HISTORY
STN: U-3ax PS#1

5/7/62 A 24" hole was drilled to 40' with a bucket rig.

5/8/62 10-3/4", 40.5# casing was cemented at 40' with 134 sacks of Gyp-Seal. Drilling equipment (Terminal #10) was moved in and 9-5/8" hole was drilled to 485'.

5/9/62 9-5/8" hole was drilled to 975' total depth. Circulation was lost while drilling at 568'. Lane Wells gamma probe was run from 770' to 939'. Pipe stuck at 780' while being pulled.

5/10/62 Drill pipe was worked up to 762' where it stuck.

5/11/62 Drill pipe was backed off at 701'. Jars were run and fish was jarred up to 687'. Fishing tools were pulled and rig was skidded 10' east to drill PS #1S.

5/15/62 Rig was skidded back over the hole and hole was cleaned out to top of fish at 687'. 8-5/8" wash pipe was run and fish was washed over causing it to drop down the hole.

5/16/62 Top of fish was found at 757' and was recovered. Homco sidewall coring tool was run and 10 samples were taken in the interval 880' to 898'. A Sperry Sun magnetic multishot survey was run from 0 to 915'. Drilling equipment was moved out.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax PS # 1S

WORK ORDER NUMBER 1213-86 H & N I.D. NUMBER 182084 E.D.S. NUMBER M-508

USER LASL TYPE HOLE Post Shot

LOCATION: NTS (NEVADA) County Nye Area 3

Coordinates N836,532.09 E687,259.79 Surface Elevation 3978.5 Grnd. 3978.34 Collar

RIG SCHEDULE: MOVED ON LOCATION 5/11/62 SPUDDED 5/11/62 COMPLETED 5/14/62

REMARKS: USER ACCEPTANCE

MUD PROGRAM: Plant mud. Gel base, 60 to 70 sec., 70#, Driscose and Soda Ash added.
Total mud used 6200 bbls.

DRILLING EQUIPMENT Terminal #10 (Ideco H-35)

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0	40'	15"	10-3/4"	40.5	J-5	ST&C	0	40	37 c/f
40'	945'	9-5/8"							Cal Seal

TOTAL DEPTH 945' WORKING POINT -- PLUGS none

JUNK None

LOGGING DATA Lane Wells gamma probe 750' to 920'. Sperry Sun magnetic multishot survey 0' to 900'.

DEVIATION DATA: M.D. 900'.00 V.D. 899.98' REFERENCE MS-321

BOTTOM HOLE COORDINATES N 836,536.71 E687, 253.12 (8.11' @ N 55° 17'W)

CORING HISTORY Homco sidewall cores. 26 samples in the interval 867' to 901'.

DRILLING HISTORY
U-3ax PS # 1S

5/11/62 Drilling Equipment (Terminal #10) was skidded from PS #1 and 15" hole was drilled to 40'.

5/12/62 10-3/4" O.D. 40.5# casing was cemented at 40' with 37 cu. ft. of Cal-Seal. 9-5/8" hole was drilled to 280'.

5/13/62 9-5/8" hole was drilled to a total depth of 945'. Circulation was lost while drilling at 569'.

5/14/62 Lane Wells gamma probe was run from 750' to 920' Homco sidewall coring tool was run and 26 samples were taken in the interval 867' to 901'. A Sperry Sun Magnetic Multishot survey was run from 0' to 900'. Drilling equipment was moved out.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3ax PS# 6

WORK ORDER NUMBER 1213-91 H & N I.D. NUMBER 182085 E.D.S. NUMBER M-627

USER LASL TYPE HOLE Post Shot

LOCATION: NTS (Nevada) County Nye Area 3

Coordinates N836,631.17 E 687,561.49 Surface Elevation 4022.3 Grnd, 4022.45 Collar

RIG SCHEDULE: MOVED ON LOCATION 5/6/62 SPUDDED 5/6/62 COMPLETED 5/10/62

REMARKS: USER ACCEPTANCE ---

MUD PROGRAM: Plant mud. Gel base, 60 to 70 secc, 70#, Driscose and Soda Ash added.

Total mud used - 4340 barrels.

DRILLING EQUIPMENT Boyles slant rig

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0	40'	9-5/8"	7"	23	J-5	ST&C	0	40	---
40'	1086.8'	6-1/4"							

TOTAL DEPTH 1086.8' WORKING POINT -- PLUGS none

JUNK None

LOGGING DATA Lane Wells temperature log 820' to 1040'. Lane Wells gamma probe 800' to 1085'.

Sperry Sun magnetic multishot survey 40' to 1086'.

DEVIATION DATA: M.D. 1086.00' V.D. 1018.31' REFERENCE MS 311

BOTTOM HOLE COORDINATES N836,436.80 E687,252.46 (365.17' @ S57° 50'W)

CORING HISTORY Homco sidewall cores. 17 samples in the interval 892' to 982'.

WELL HISTORY
U-3ax PS #6

5/6/62 Boyles slant rig was moved in and 9-5/8" hole was drilled to 40'. 7" O.D. 23# casing was cemented at 40'. Rig was moved out for shot.

5/7/62 Rig was moved back in and 6-1/4" hole was drilled to 153'.

5/8/62 6-1/4" hole was drilled to 1016.8'. Circulation was lost while drilling at 212'.

5/9/62 6-1/4" hole was drilled to a total depth of 1086.8'.
Lane Wells temperature log was run from 820' to 1040'.
Lane Wells gamma probe was run from 800' to 1085'. Homco sidewall coring tool was run and 17 samples were taken in the interval 892' to 982'.

5/10/62 Sperry Sun magnetic sultishot survey was run from 40' to 1086'.
Drilling equipment was moved out.

ST U-3ax-PS-1S

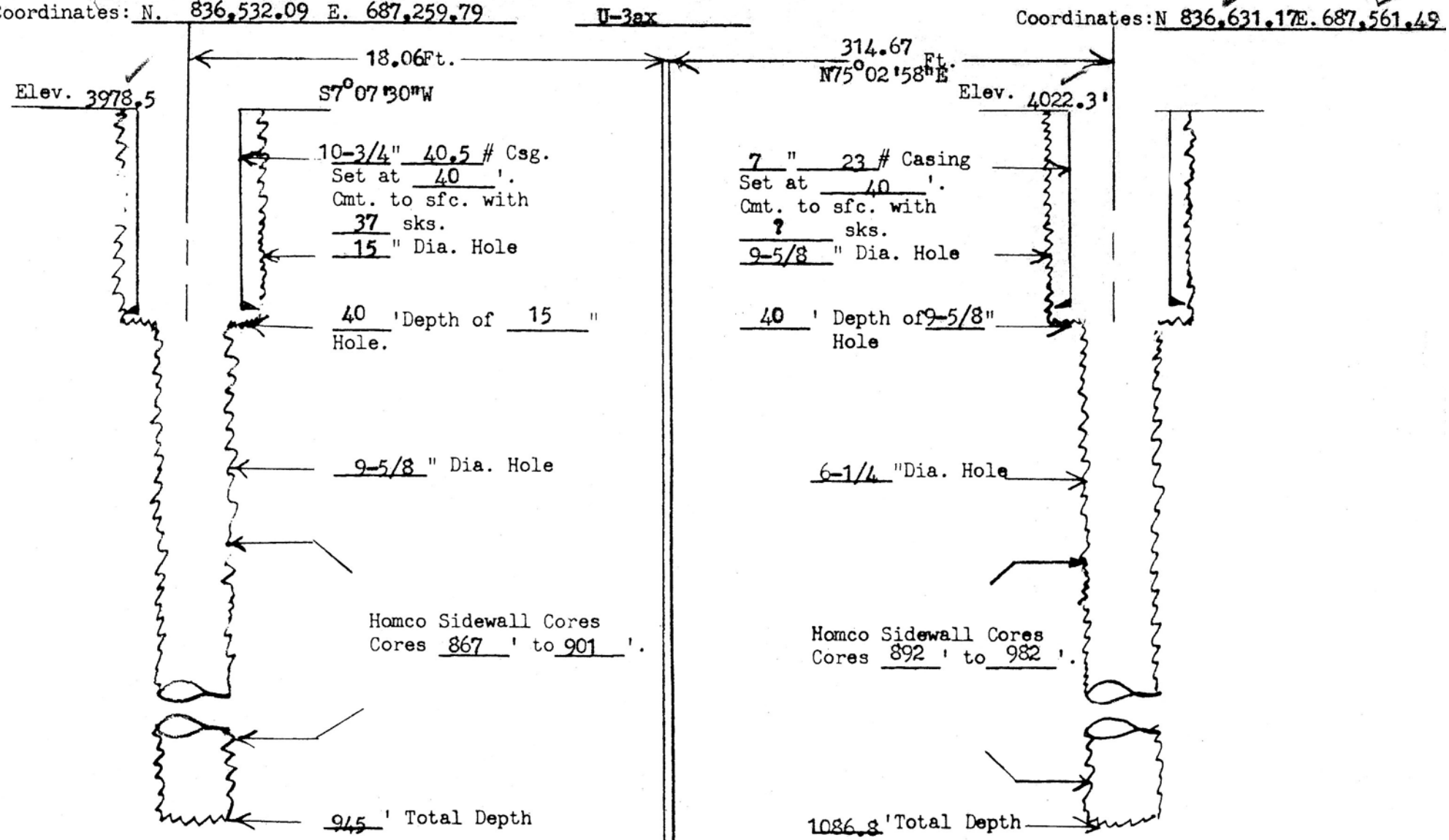
Coordinates: N. 836,532.09 E. 687,259.79

EMPLACEMENT HOLE

U-3ax

STN: U-3ax-PS-6

Coordinates: N 836,631.17 E. 687,561.49



REMARKS: Logs Lane Wells gamma probe

Survey Sperry Sun magnetic multishot

Btm. Hole
Coordinates: N 836,536.71 E. 687,253.12

REMARKS: Logs Lane Wells temperature log
Lane Wells gamma probe

Survey Sperry Sun Magnetic Multishot

Btm. Hole
Coordinates: N 836,436.80 E. 687,252.46

RVQ/hh
4/20/62

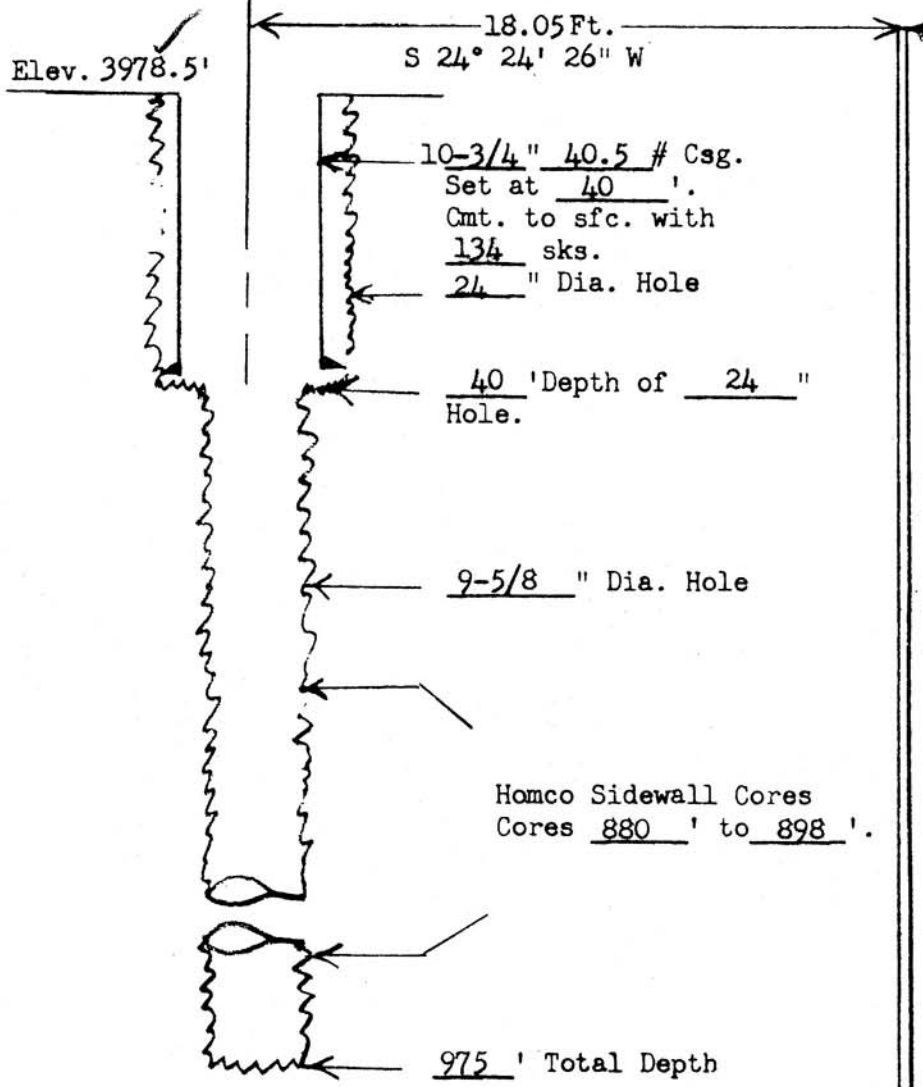
STN: U-3ax PS # 1

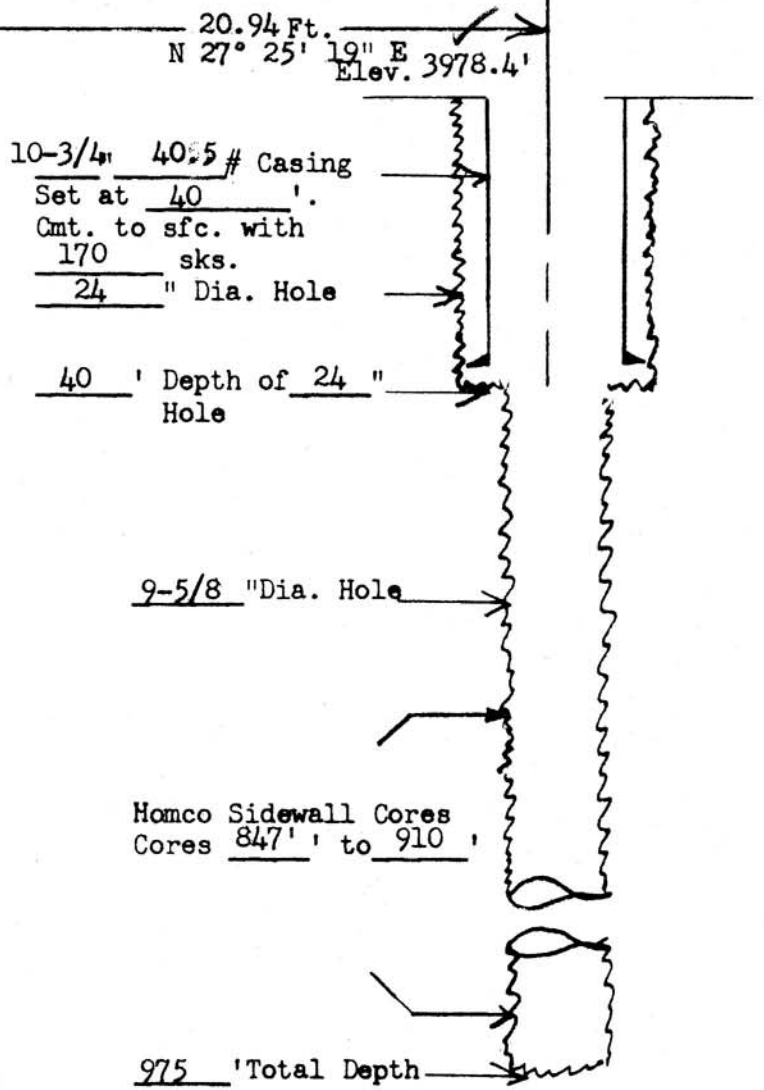
Coordinates: N. 836,523.57 E. 687,250.09

EMPLACEMENT: U-3ax

STN: U-3ax PS # 2

Coordinates: N 836,568.59 E. 687,267.19





REMARKS: Logs Lane Well Gamma Probe

Survey Sperry Sun Magnetic Multishot

Btm. Hole
Coordinates: N N836,523.81 E. 687,239.44

REMARKS: Logs Lane Wells Gamma Probe

Survey Sperry Sun Magnetic Multishot

Btm. Hole
Coordinates: N 836,564.91 E. 687,260.68

RVQ/hh
4/20/62

Appendix E

Hole Histories for Holes Drilled for the U3bl Event

U-3bl-1
U-3bl-2
U-3bl-3S
U-3bl-3
U-3bl PS #1
U-3bl PS#2

HOLMES & NARVER INC.,

WELL HISTORY DATA

REVISED WELL HISTORY

HOLE NUMBER U-3b1-1

WORK ORDER NUMBER 1215-29 H&N I.D. NUMBER 182751 E.D.S. NUMBER

USER LASL TYPE HOLE Instrument

LOCATION Nevada (N.T.S.) County Nye AREA 3

Surface Coordinates N836,423.56 E687,600.50 Ground Elevation 4021.01

RIG SCHEDULE: MOVED ON LOCATION 7-23-62 SPUDDED 7-24-62 COMPLETED 8-26-62

REMARKS Hole idle from 7-27-62 to 8-26-62 Incl.

CIRCULATING MEDIA Air

Nº OF COMPRESSORS & SIZE

DRILLING EQUIPMENT Bucket rig to set conductor, National T-20 to cementing of 10-3/4" Csg.
Ideco H-35 to drill 9-5/8" hole.

HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I.D.	WT/FT.	WALL THICK.	GRADE	COUPLING	FROM	TO	CU. FT. CEMENT
0'	40'	26"	18"	Conductor				0'	40'	110 cu.ft.
40'	480'	15"	10-3/4"	40.5#		J-55	ST&C	0'	480'	696 cu.ft.
480'	720'	9-5/8								

TOTAL DEPTH 720' MANDREL DEPTH PLUGS

JUNK

LOGGING DATA Sperry Sun Gyroscopic Multishot from surface to ~~712'~~ 707'.

DEVIATION DATA M.D. 712' V.D. REFERENCE SUR 419

HOLE COORDINATES @ N836,421.99 E687,604.22

CORING HISTORY None Taken

REVISION March 9, 1963 DATE March 9, 1963

WRITTEN BY CHECKED BY

Well History
Stn. U-3bl-1

6-11-62 Moved in bucket rig and drill 26" hole to 40'. Cemented 18" casing to surface with 110 cu ft. of cement & moved off.

7-23-62 Moved in National T-20 rig, worked on mast and rigged up.

7-24-62 Spudded in and drilled 15" hole to 77', using air as a drilling media.

7-25-62 Drilled 15" hole from 77' to 480'. Conditioned hole to run casing. Ran and cemented new 10 3/4" - 40.5#, J- 55 ST&C casing at 480' with 480 cu ft. of cement pretreated with 15# cu ft. gilsonite, 1% Halad-9, 2% $CaCl_2$ & 12% gel. Cement did not surface. Pumped in 216 cu ft. of neat cement in the annulus.

7-26-62 Stood cemented 12 hours. Landed 10 3/4" casing and suspended the well 7-26-62. Rigged down and moved off.

8-26-62 Moved in Ideco H-35 & rigged up. Ran in with 9 5/8" bit and blew the hole dry in stages. Drilled 9 5/8" hole from 480' to 720'. Conditioned hole and ran Sperry Sun Gyroscopic Multishot from surface to 707'. Measured in with drill pipe and bit, found top of fill-@ 712'. Cleaned out from 712' to 720'. Blew hole clean. Pulled out of hole and laid down drill pipe. Hole completed.

HOLMES & NARVER INC.

WELL HISTORY DATA

REVISED WELL HISTORY

HOLE NUMBER U-3b1-2

WORK ORDER NUMBER 1215-29 H&N I.D. NUMBER 182751 E.D.S. NUMBER

USER LASL TYPE HOLE Instrument

LOCATION Nevada (NTS) County Nye AREA 3

Surface Coordinates N836,435.22 E687,599.42 Ground Elevation 4021.0'

RIG SCHEDULE: MOVED ON LOCATION 6-13-62 SPUDDED 6-13-62 COMPLETED 8-3-62

REMARKS Hole suspended 6-14-62 to 8-2-62

CIRCULATING MEDIA Air

Nº OF COMPRESSORS & SIZE

DRILLING EQUIPMENT Bucket rig to drill conductor. National T-20 for balance of hole.

TYPE HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I.D.	WT/FT	WALL THICK.	GRADE	COUPLING	FROM	TO	CU. FT. CEMENT
0'	40'	26"	18"	Conductor					40'	110 cu.ft.
40'	480'	15"	10-3/4"	40.5		J-55	BW	0'	480'	755 cu.ft.
480'	720'									

TOTAL DEPTH 720' MANDREL DEPTH PLUGS

JUNK

LOGGING DATA Sperry Sun Gyroscopic Multishot Survey from surface to 725'.

DEVIATION DATA M.D. 725' V.D. 725' REFERENCE SUR 420

HOLE COORDINATES @ N836,434.08 E687,599.31

CORING HISTORY None taken

REVISION March 9, 1963 DATE March 9, 1963

WRITTEN BY CHECKED BY

Well History
Stn. U-3b1-2

6-11-62 Moved in bucket rig and drilled 26" hole to 40'. Cemented 18" casing at 40' with 110 cu ft. of cement. Moved out.

6-13-62 Moved in National T-20 & rigged up. Spudded in and drilled 15" hole to 480' using air as a drilling media.

6-14-62 Ran and cemented 10 3/4" - 40.5#, J-55, ST&C casing at 480', cemented through Baker guide shoe with 580 cu ft. of cement pre-mixed with 2% hydrated gel., 15# cu ft. gilsonite, 1% Halad9 & 2% $CaCl_2$. Full cement returns at surface and then fell away. Stood cemented 4 hours. Filled annulus with 175 cu ft. of neat cement. Cut off casing. Well suspended this date.

8-2-62 Moved in National T-20 & rigged up. Ran in with 9 7/8" bit and located top of cement at 347'. Drilled out cement and shoe and made 9 7/8" hole to 618'.

8-3-62 Drilled 9 7/8" hole from 618' to 720'. Conditioned hole to run Sperry Sun. Ran Sperry Sun Gyroscopic Multishot Survey from surface to 725'. Measured in with drill pipe to 720.29'. Laid down drill pipe and hole completed this date.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3b1-3S

WORK ORDER NUMBER 1215-29 H & N I.D. NUMBER 182751 E.D.S. NUMBER

USER LASL TYPE HOLE Instrument

LOCATION: Nevada *NTS* County Nye Area 3

Coordinates N836,404.01 E687,653.80 Surface Elevation 4020.6

RIG SCHEDULE: MOVED ON LOCATION 8-10-62 SPUDDED 8-10-62 COMPLETED 8-16-62

REMARKS: USER ACCEPTANCE 8-16-62

MUD PROGRAM: Air to T.D. and clay base mud to complete.

DRILLING EQUIPMENT National T-20

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	40'	26"	18"	Surface			0'	40'	100 cu ft
40'	480'	15"	10 3/4"	40.5#	J-55	ST&C	0'	480'	785 cu ft

TOTAL DEPTH 770' q/sfg WORKING POINT PLUGS Fill 770' to 682'

JUNK None

LOGGING DATA Sperry Sun Multishot and Gyroscopic surveys to 715'.

DEVIATION DATA: M.D. 715' V.D. 715' REFERENCE SUR-427 MS-428

BOTTOM HOLE COORDINATES N836,404.01, E687,652.47

CORING HISTORY None Taken

Well History
Stn. U-3b1-3S

8-9-62 Moved in Portadrill and drilled 40' of 26" hole. Ran and cemented 18" casing at 40' with 100 cu ft. cement with 2% $CaCl_2$. Moved out Portadrill.

8-10-62 Moved in National T-20 and rigged up. Drilled out shoe and made 15" hole to 480' using air as a circulating media. Conditioned hole for casing. Ran and cemented new 10 3/4", 40.5#, J-55, ST&C casing at 480' with 480 cu ft. cement with 2% gel, 15# cu ft. gilsonite, 1% Halad 9 and 2% $CaCl_2$. Stood cemented. Cemented annulus with 305 cu ft. of cement with 1-1 perlite & 2% $CaCl_2$.

8-11-62 Stood cemented 12 hours. Landed 10 3/4" casing. Drilled out shoe and made 9 5/8" hole to 712'. Hole started sloughling while drilling @712', plugged bit while making a connection. Pulled out and unplugged bit. Hit fill at 624'. Cleaned out to 640'.

8-12-62 Blew hole open to 675', unable to make a connection, hole filled to 640'. With open end drill pipe hung at 638' pumped in 150 cu ft. of cement with 2% $CaCl_2$. Pulled up to 480' and pumped in 98 cu ft. cement. Stood cemented 4 hours. Ran in and located top of cement at 547'. Made trip to unplug bit. Cleaned out from 480' to 547'. Cleaned out 9 5/8" hole from 547' to 646', hard cement @ 616'. With open end drill pipe hung at 614' pumped in 150 cu ft. of cement with 2% $CaCl_2$. Stood cemented 4 hours. Top of fill 608'. Cleaned out from 599'.

8-13-62 Cleaned out to 649' with open end drill pipe hung at 615' pumped in 300 cu ft. of cement with 12# cu ft. gilsonite with 2% gel and 2% HA-5. W.O.C. 4 hours. Located top of cement at 546', cleaned out with 9 5/8" bit to 584'. Heavy sand returns and sloughing. Received orders to change from air to mud. Cleaned out with mud, returns @ 650'.

8-14-62 Cleaned out to 712' and drilled 9 5/8" hole to 770'. Hole tight at 730'. Bailed hole to 600'.

8-15-62 Bailed hole to 715'. Ran Sperry Sun gyroscopic survey to 500' and Magnetic survey to 715'. Bailed at rate of 10 Bbls/hour.

8-16-62 Bailed hole dry to 682'. Hole filled in below this point. Hole completed 8-16-62. Rigged down and moved off.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3b1-3

WORK ORDER NUMBER 1215-29 H & N I.D. NUMBER 182751 E.D.S. NUMBER

USER LASL TYPE HOLE Instrument

LOCATION: Nevada - N.T.S. County Nye Area 3

Coordinates N836,453.27 E687,600.37 Surface Elevation 4021.0

RIG SCHEDULE: MOVED ON LOCATION 6-12-62 SPUDDED 6-12-62 Abandoned COMPLETED 8-11-62

REMARKS: Hole idle 6-14-62 thru 8-2-62 and on 8-10-62 USER ACCEPTANCE

MUD PROGRAM: Air

DRILLING EQUIPMENT Ideco H-35 to 680' (pulled in mast)
National T-20 to finish.

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	40'	26"	18"	Surface	Pipe		0'	40'	50 cu. ft
40'	480'	15"	10 3/4"	40.5#	J-55	ST&C	0'	480'	605 cu. ft.
480'	720'	9 5/8"							

TOTAL DEPTH 720' WORKING POINT PLUGS 720' to 519' & 458' to surface.

JUNK None

LOGGING DATA None

DEVIATION DATA: M.D. V.D. REFERENCE

BOTTOM HOLE COORDINATES

CORING HISTORY None taken.

Well History
Stn. U-3bl-3

6-11-62 Moved in bucket rig and drilled 26" hole to 40'. Set and cemented 18" casing @ 40' with 50 cu ft. Cal-Seal. Moved off.

6-12-62 Moved in Ideco H-35 rig and rigged up. Drilled out shoe and made 15" hole to 300', using air as a drilling media.

6-13-62 Drilled 15" hole from 300' to 480'. Ran and cemented new 10 3/4", 40.5# casing at 480' with 580 cu ft. cement permixed with 2% gel., 15# cu ft. gilsonite and 1% Halad 9. Cemented annulus with 25 cu ft. cement. Stood cemented 8 hours and landed 10 3/4" casing. Rigged down and moved off. Well suspended 6-13-62

6-14-62 thru 8-2-62 No activity.

8-3-62 Moved in Ideco H-35, drilled out shoe and made 9 5/8" hole to 680' using air as a drilling media. Pipe stuck at 670', pulled in top section of mast while working pipe. Moved out rig and replaced it with National T-20.

8-4-62 Ran inside of $4\frac{1}{2}$" drill pipe with $1\frac{1}{4}$" tubing, unable to circulate. Ran $1\frac{1}{4}$" tubing on outside of drill pipe and cleaned out to 677'. Worked pipe free.

8-5-62 Drilled 9 5/8" hole from 677' to 701'. Made trip and measured drill pipe. Had to drill from 592'. Hole sloughling badly at 661'. Plugged bit while drilling at 701'. Round trip to unplug bit. Drilled 9 5/8" hole from 701' to 710'.

8-6-62 Pulled drill pipe up in 10 3/4". Welded plate on U-3bl-2. Ran in to bottom no returns. Pulled out bit not plugged. Ran in to 480', circulation OK. Hole sloughed in on drill pipe with bit @ 648'. Pulled plugged bit, cleaned bit and reamed. Cleaned out sloughing gravel from 604' to 649'. Ran in to cement back. Blowing hole to clean out from 637' to 691'. Unable to make connection, at 690'.

8-7-62 With open end drill pipe hung at 690' pumped in 50 sxs Hydrogel followed by 100 cu ft. of Cal Seal 1-1 mix. Stood cemented 6 hours. Ran in with 9 5/8" bit, broke circulation at 480'. Cleaned out sloughed hole from 674' to 710'. Drilled 9 5/8" hole 710' to 720'. Short trip to check fill, had to clean out 34'. Made trip and ran in with 9 5/8" diamond point bit, blowed hole clean, pulled up 50' and shut off air for 5 minutes. Found 40' of fill. Cleaned out to bottom. With open end drill pipe hung at 720' pumped in 100 cu ft. cement.

8-8-62 Stood cemented 8 hours. Located top of fill at 627', cleaned out to 710'. Measured out of hole, stayed on bank one hour, re-ran drill pipe and located top of fill at 689', cleaned out to 710'. Ran in with 9 5/8" bit and cleaned out fill from 618' to 628'. Pulled up 50' and shut air off for 30 minutes, found fill to 624'. With open end drill pipe hung @ 620' pumped in 100 cu ft. cement 1-1 perlite with 4% gel and 2% $CaCl_2$. Located top of cement at 543'. With open end drill pipe hung at 512' pumped in 100 cu ft. cement 1-1 perlite with 4% gel and 2% $CaCl_2$.

8-9-62 Stood cemented 4 hours. With open end drill pipe hung at 488' pumped in 100 cu ft. cement 1-1 perlite with 4% gel and 2% $CaCl_2$. Stood cemented 4 hours. Tagged top of cement at 519'. With open end drill pipe hung @ 488' pumped in 100 cu ft. cement 1-1 perlite with 4% gel and 2% $CaCl_2$. Rigged down and moved out.

8-10-62 Hole idle.

8-11-62 Moved in portadrill rig and pushed HOWCO plug to 450'. Placed 2 xsxs Cal-Seal on top of plug. Felt for plug in one hour, plug not in place. Set HOWCO plug with drill pipe at 458'. Pumped in 10 sxs Cal-Seal, followed by 237 cu ft. cement with 2% $CaCl_2$. 10 3/4" plugged to surface. Rigged down and moved out. Hole abandoned 8-11-62.

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3bl PS-1

WORK ORDER NUMBER 1216-40 H & N I.D. NUMBER 182753 E.D.S. NUMBER

USER LASL TYPE HOLE Post Shot

LOCATION: Nevada (N.T.S.) County Nye Area 3

Coordinates N836,405.73 E687,585.29 Surface Elevation 3991.3

RIG SCHEDULE: MOVED ON LOCATION 8-24-62 SPUDDED 8-24-62 COMPLETED 8-25-62

REMARKS: USER ACCEPTANCE 8-25-62

MUD PROGRAM: Gel. & Water

DRILLING EQUIPMENT National T-20

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	38'	17½"	10 3/4"	Surface			0'	38'	56 cu ft.
38'	768'	9 5/8"							

TOTAL DEPTH 768' WORKING POINT - PLUGS None

JUNK None

LOGGING DATA Lane Wells Gamma ray and temperature logs to 768'.

Sperry Sun Magnetic survey to 766'.

DEVIATION DATA: M.D. 765' V.D. 764.81' REFERENCE SUR - 434

BOTTOM HOLE COORDINATES @765' N836,413.53, E687,595.14

CORING HISTORY None taken.

Well History
Stn. U-3b1 PS-1

8-24-62 Moved in Portadrill on crater floor. Drilled 17½" hole to 38'. Set and cemented 10 3/4" casing at 38' with 56 cu ft. of Cal-Seal. Moved out portadrill rig. Moved in National T-20 rig, drilled out 10 3/4" shoe and made 9 5/8" hole to 164'.

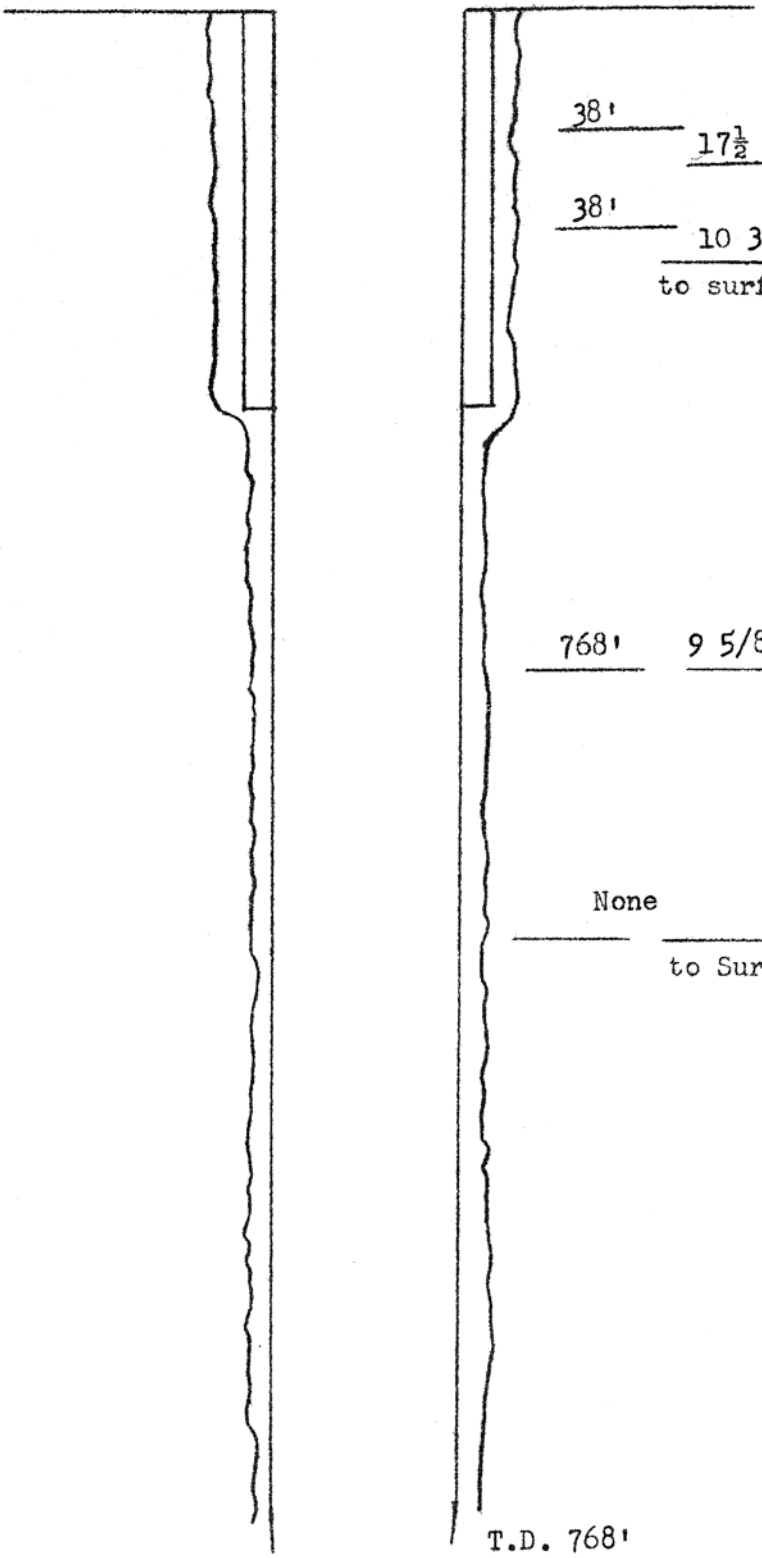
8-25-62 Drilled 9 5/8" hole from 164' to 768'. Lost circulation while drilling at 490'. Ran Lane Wells gamma ray & temperature logs to 768'. Took Homco side wall samples. Ran Sperry Sun Magnetic survey to 766'. Rigged down and moved out. Hole completed 8-25-62.

Post Shot HOLE

U-3bl PS-1

COORDINATES: N. 836,405.73 E. 687,585.29

ELEV. 3991.3



38' 17½ "Diameter Hole

38' 10 3/4 " 32 # Casing Cemented to surface in 17½ " Diameter Hole

768' 9 5/8 " Diameter Hole

None # Casing Cemented to Surface in " Diameter Hole

T.D. 768'

BOTTOM COORDINATES N. 836,413.53 E. 687,595.14

HOLMES & NARVER, INC.
WELL HISTORY DATA

HOLE NUMBER U-3bl PS-2

WORK ORDER NUMBER 1216-40 H & N I.D. NUMBER 182753 E.D.S. NUMBER

USER LASL TYPE HOLE Post Shot

LOCATION: Nevada (N.T.S.) County Nye Area 3

Coordinates N836,406.05 E687,614.96 Surface Elevation 3991.3

RIG SCHEDULE: MOVED ON LOCATION 8-24-62 SPUDDED 8-24-62 COMPLETED 8-26-62

REMARKS: USER ACCEPTANCE 8-26-62

MUD PROGRAM: Gel. & Water

DRILLING EQUIPMENT Ideco H-35

BORE HOLE RECORD			CASING RECORD						
FROM	TO	SIZE	SIZE	WEIGHT	GRADE	COUPLING	FROM	TO	SACKS CEMENT
0'	38'	15"	10 3/4"	Surface			0'	38'	59 cu ft.
38'	765'	9 5/8"							

TOTAL DEPTH 765' WORKING POINT PLUGS

JUNK None

LOGGING DATA Sperry Sun Multishot to 770'.

Lane Wells Temperature and gamma ray to 773'.

DEVIATION DATA: M.D. 770' V.D. 769.94' REFERENCE SUR - 435

BOTTOM HOLE COORDINATES @770' N836,406.74 E687,618.50

CORING HISTORY None taken

Well History
Stn. U-3b1 PS-2

8-24-62 Moved Portadrill into floor of crater. Drilled 15" hole to 38'. Set and cemented 10 3/4" casing at 38' with 59 cu ft. cement. Moved out portadrill and moved in Ideco H-35.

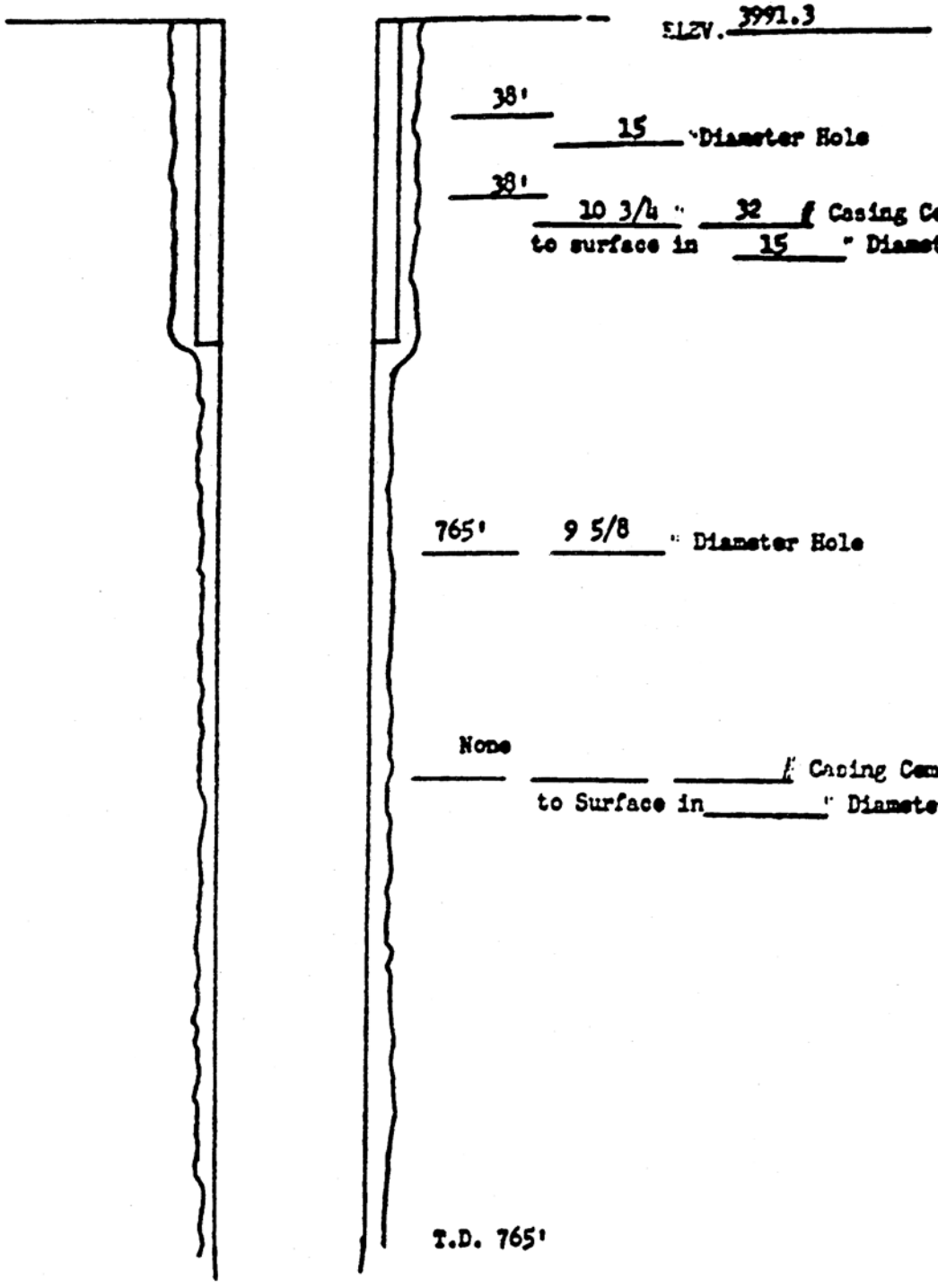
8-25-62 Drilled out shoe & made 9 5/8" hole to 765'. Lost circulation @ 499'. Ran Lane Wells Temperature and Gamma ray logs to 773'. Took Homco sidewall samples.

8-26-62 Ran Sperry Sun multishot to 770'. Laid down drill pipe. Rigged down and moved out. Well completed 8-26-62.

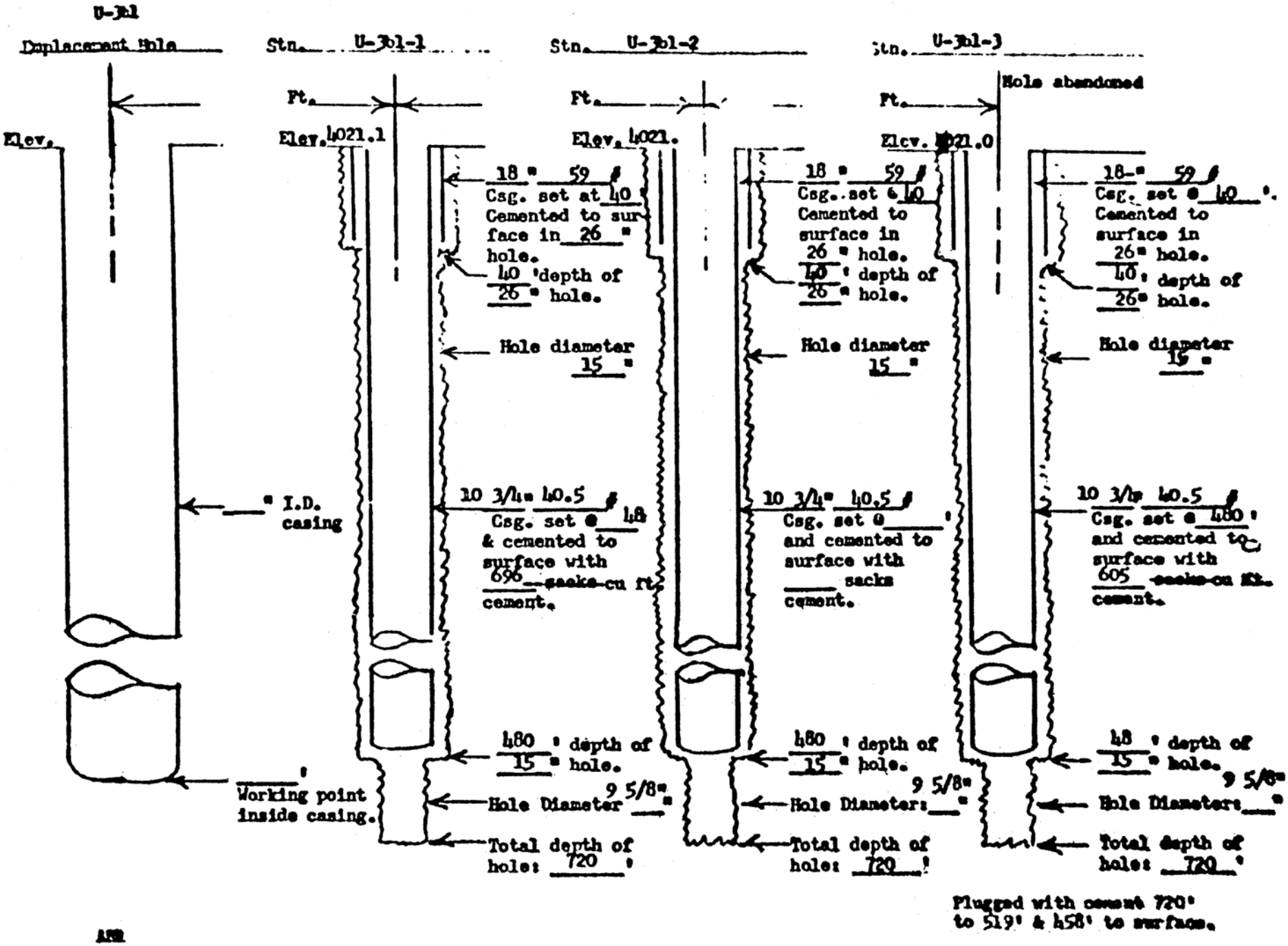
Post Shot HOLE

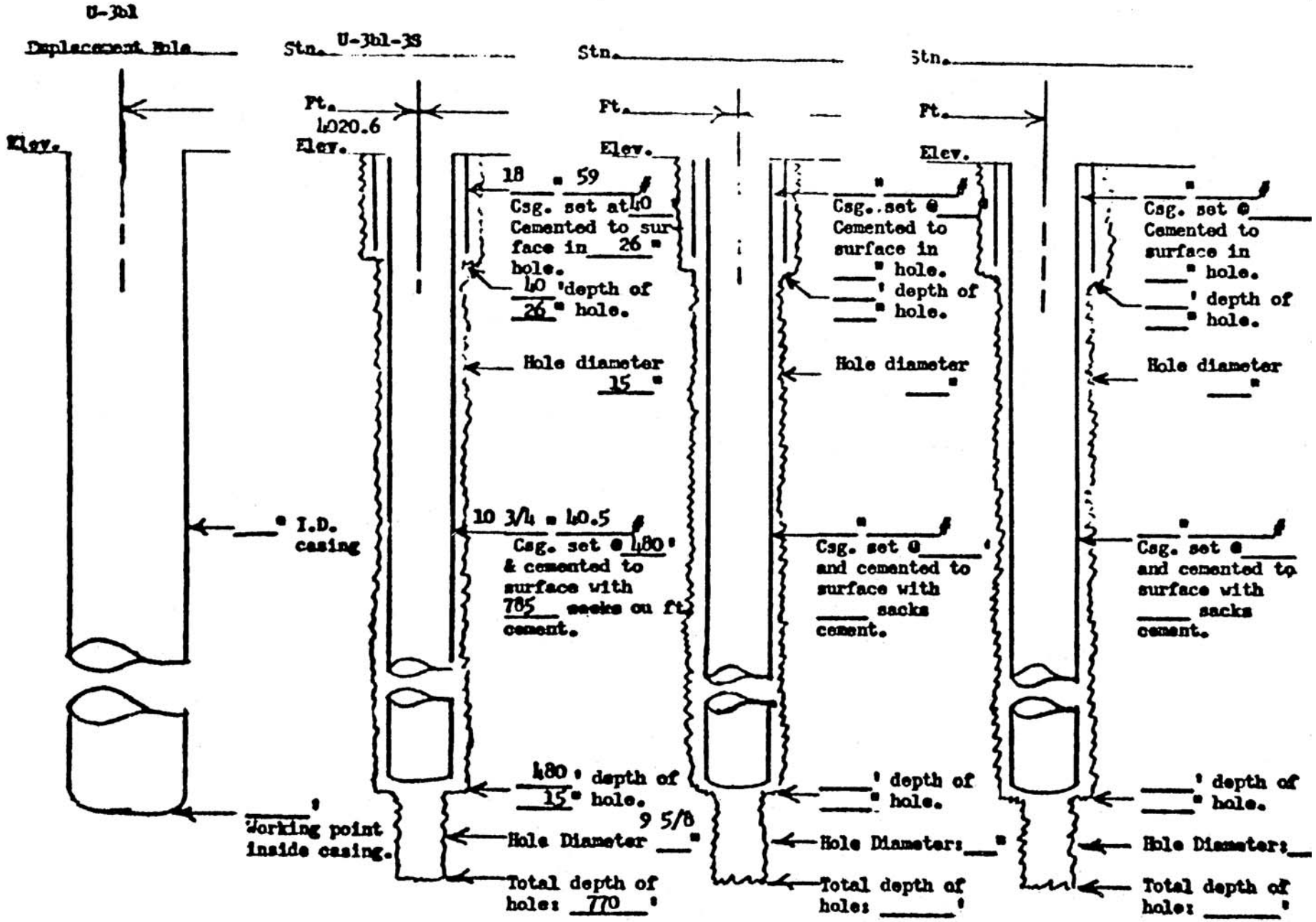
U-3bl PS-2

COORDINATES: N. [illegible] E. [illegible]



BOTTOM COORDINATES N. 836,406.74 E. 687,618.50


U-3b1
Displacement Hole
Stn. U-3b1-1
Stn. U-3b1-2
Stn. U-3b1-3
Hole abandoned
Ft.
Ft.
Ft.
Elev.
Elev. 4021.1
Elev. 4021.
Elev. 4021.0
18 " 59 #
Csg. set at 40 '
Cemented to surface in 26 " hole.
40 ' depth of 26 " hole.
Hole diameter 15 "
" I.D. casing
10 3/4" 40.5 #
Csg. set @ 48 '
& cemented to surface with 696 sacks cement.
480 ' depth of 15 " hole.
' Working point inside casing.
Hole Diameter 9 5/8"
Total depth of hole: 720 '
18 " 59 #
Csg. set @ 40 '
Cemented to surface in 26 " hole.
40 ' depth of 26 " hole.
Hole diameter 15 "
10 3/4" 40.5 #
Csg. set @ ' and cemented to surface with sacks cement.
480 ' depth of 15 " hole.
Hole Diameter: "
Total depth of hole: 720 '
18" 59 #
Csg. set @ 40 '.
Cemented to surface in 26" hole.
40 ' depth of 26" hole.
Hole diameter 15 "
10 3/4" 40.5 #
Csg. set @ 480 ' and cemented to surface with 605 sacks cement.
48 ' depth of 15 " hole.
9 5/8"
Hole Diameter: "
Total depth of hole: 720 '
Plugged with cement 720' to 519' & 458' to surface.
MM
4-17-62


U-3bl
Displacement Hole
Stn. U-3bl-3S
Stn.
Stn.
Ft.
1020.6
Elev.
Ft.
Elev.
Ft.
Elev.
18 = 59
Csg. set at 40
Cemented to surface in 26 " hole.
40 ' depth of 26 " hole.
Hole diameter 15 "
10 3/4 = 40.5
Csg. set @ 480 '
& cemented to surface with 785 sacks cu ft cement.
" I.D. casing
480 ' depth of 15 " hole.
' Working point inside casing.
9 5/8
Hole Diameter "
Total depth of hole: 770 '
" Csg. set @ Cemented to surface in " hole.
' depth of " hole.
Hole diameter "
" Csg. set @ and cemented to surface with sacks cement.
' depth of " hole.
Hole Diameter: "
Total depth of hole: '
" Csg. set @ Cemented to surface in " hole.
' depth of " hole.
Hole diameter "
" Csg. set @ and cemented to surface with sacks cement.
' depth of " hole.
Hole Diameter: "
Total depth of hole: '

ANR
4-17-6

Appendix F

U3lb site characterization

Note: From containment prospectus.

Site Characterization

An existing inventory hole, U3lb, has been selected for NAVATA. A DOB of 183 m has been chosen, using the minimum DOB convention. This emplacement hole is situated in north-central Area 3 and is in unsaturated tuffaceous alluvium. The hole construction history does not indicate any geologic pecularities encountered during drilling.

Surface features of interest in the area are shot-related radial and concentric fractures and the Area 3 fault (Figure 5). Some minor fracturing has occurred along the fault as a result of the BILBY (U3cn) and SCAUP (U3dsS) events conducted in 1963 and 1965, respectively. Within one DOB of U3lb there were two minor discontinuous cracks mapped which are no longer visible. The U3eo (FAWN) collapse sink and associated concentric cracks to the northwest extend to within approximately 110 m of the NAVATA SGZ. The closest approach from the NAVATA WP to the FAWN chimney is estimated to be 155 m (14.6 R_c). CANFIELD (U3kx), 300 m NNE, collapsed to the surface and produced only minor surface effects and no cracking along the Area 3 fault.

Since U3lb did not penetrate the tuffs (Appendix Table A-2, lithologic summary), the stratigraphy below the alluvium is projected from nearby holes, primarily U3kx (Appendix Table A-3) which is in a very similar structural setting. Based on the USGS gravity interpretation, the Paleozoic surface is estimated to be some 850 m below the WP. The nearest drill hole which penetrated the Pz surface is U3cn-5, located approximately 725 m north of U3lb. The Pz was tagged at 860 m. The alluvium/tuff contact in U3lb is predicted to be at a depth of 275 m, 91 m below the WP. The static water level (SWL) depth is predicted at approximately 491 m.

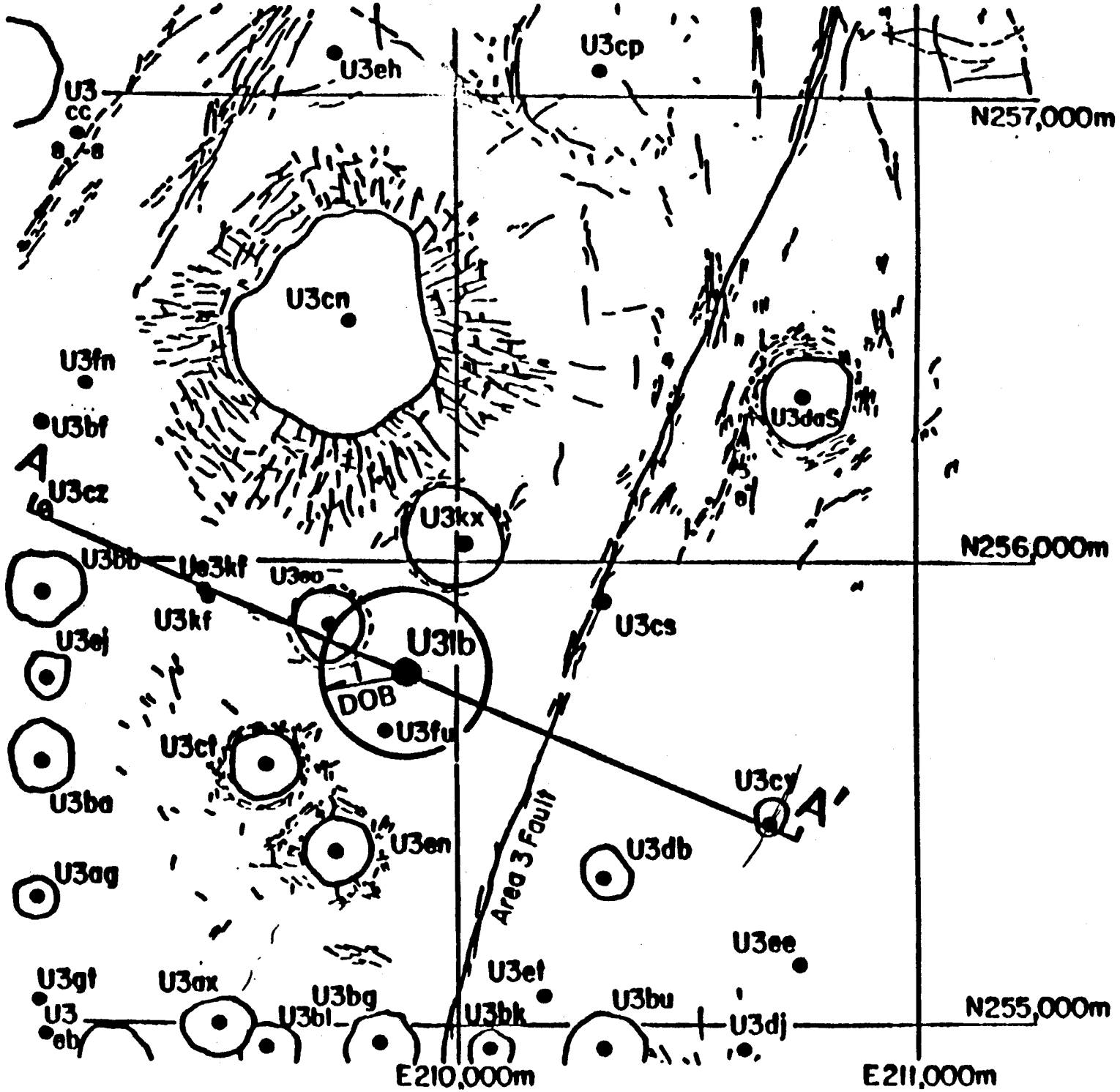
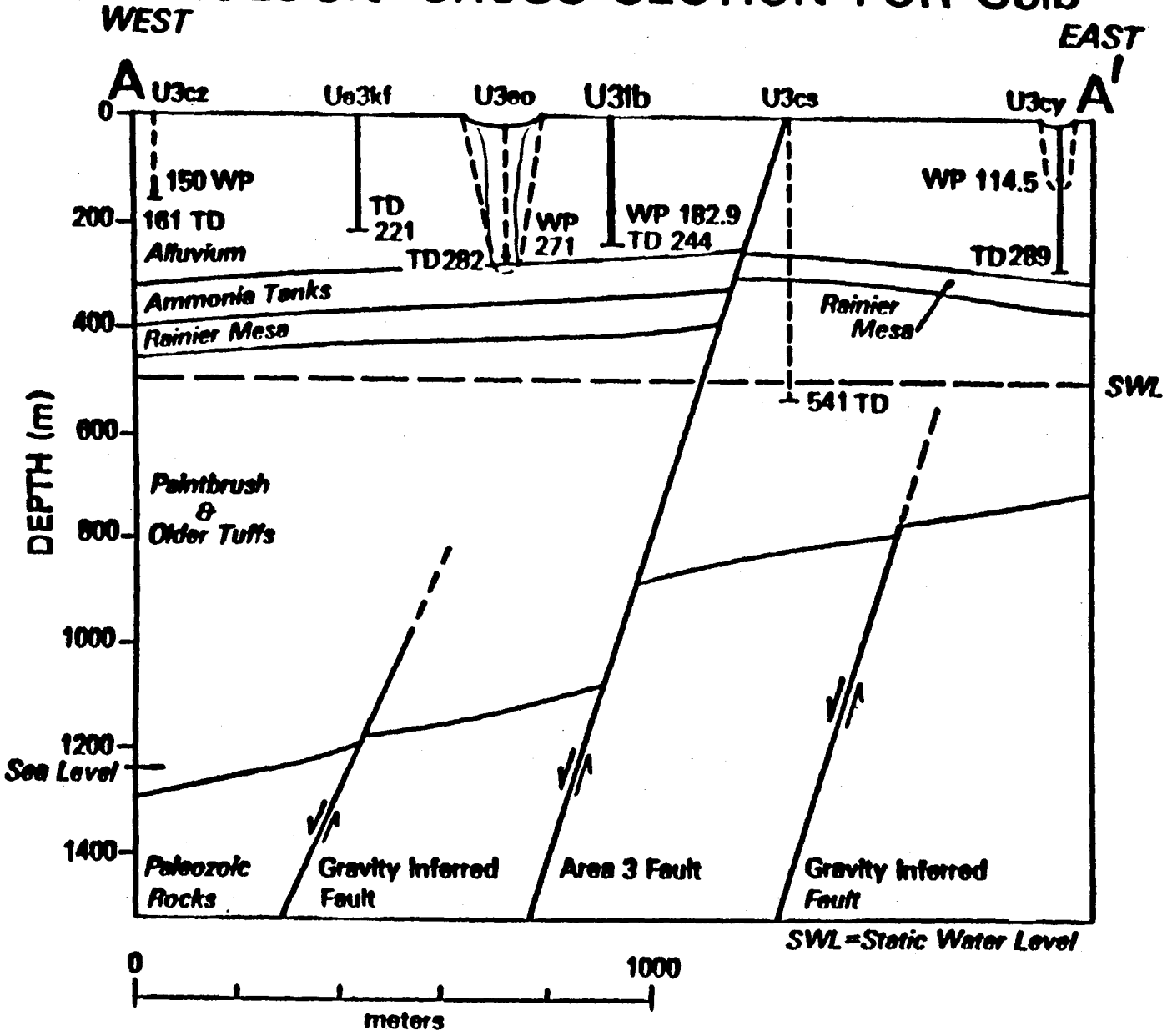

U3cp
U3eh
U3
cc
N257,000m
U3cn
U3fn
U3bf
U3daS
A
U3cz
U3kx
N256,000m
U3bb
Ue3kf
U3eo
U3kf
U3cs
U3ej
U3lb
1
DOB
U3fu
U3ct
U3cy
A'
U3ba
U3en
U3db
U3ag
Area 3 Faults
U3ee
U3gl
U3ax
U3bg
U3ef
U3bu
U3
eb
U3bl
U3bk
U3dj
N255,000m
E210,000m
E211,000m

Figure 5

GEOLOGIC CROSS SECTION FOR U3lb



In order to best depict the structural setting the geologic cross section (Figure 6) was constructed normal to the structural trend of approximately N23°E. The major structural feature in the vicinity is the Area 3 fault to the east. At closest approach the fault plane is more than 240 m from the shot-point. The USGS gravity interpretation (Appendix Figure A-1) shows a fault to the west in the pre-Cenozoic rocks, but there is no surficial evidence of this fault. BILBY did not produce any surface cracks in this location.

Plots of the caliper, resistivity, density, and geophone velocity logs are shown in Figure 7. The caliper log, run on 4 July 1982, shows a very smooth hole for alluvium with the maximum enlargement at 230 m to 1.51 m. This is 14% greater than the bit size of 1.32 m. Indicated areas of enlargement are all outside the max-cred cavity region.

No zones of low resistivity were noted on the electric log. Resistivities are generally between 200 and 300 ohmmeters with a minimum of approximately 100 ohmmeters at 124 m depth.

The density log indicates an average of 1.64 Mg/m^3 for the overburden and 1.74 Mg/m^3 for the max-cred cavity region. These values are well within previous experience for Area 3 alluvium.

The geophone log indicates average velocities of 1235 m/sec for the overburden and 1524 m/sec for the max-cred cavity region, which compare very well with those in U3kx at the same depths and with other holes with similar working point environments.

HOLE LOGS U3lb

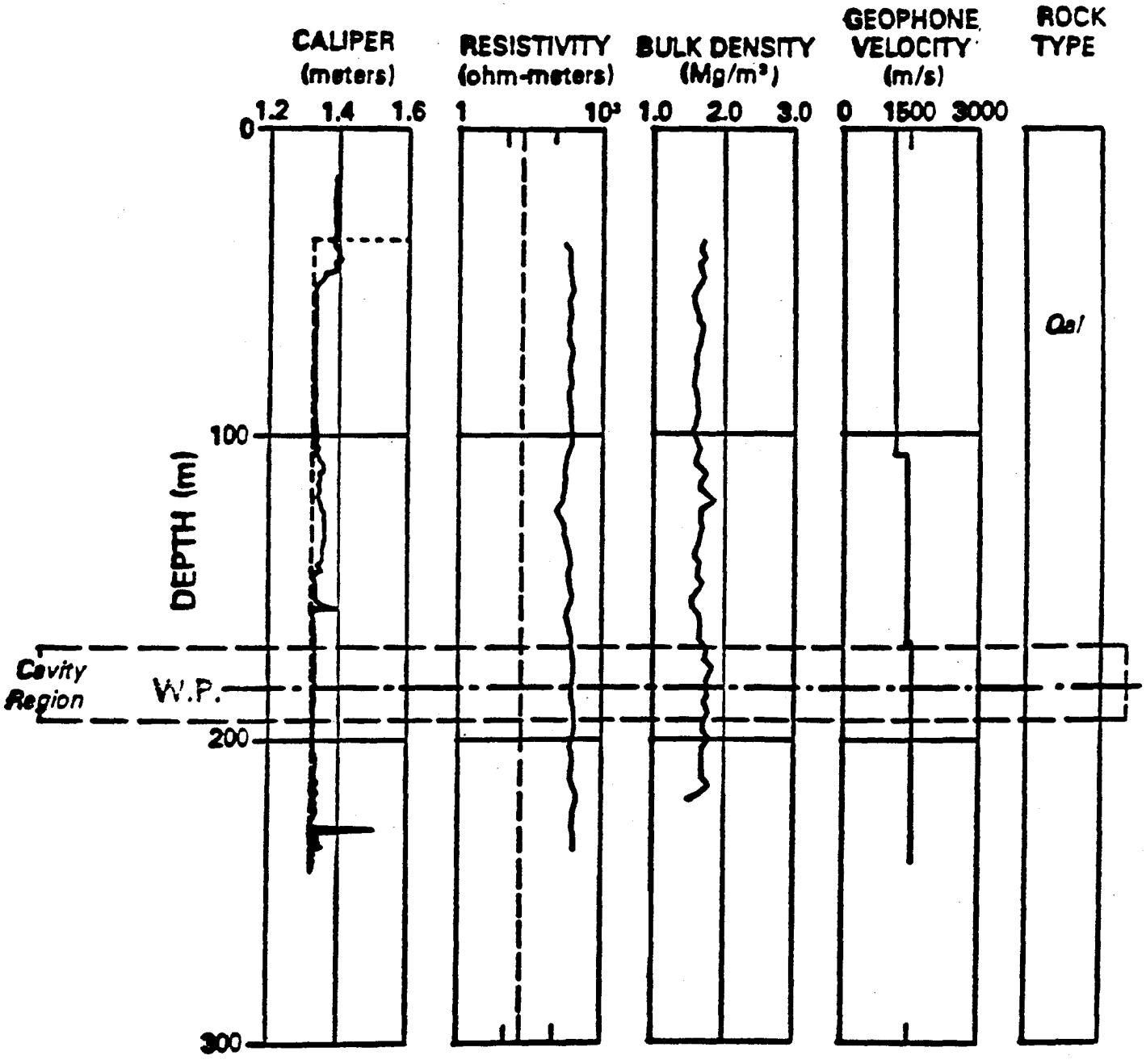


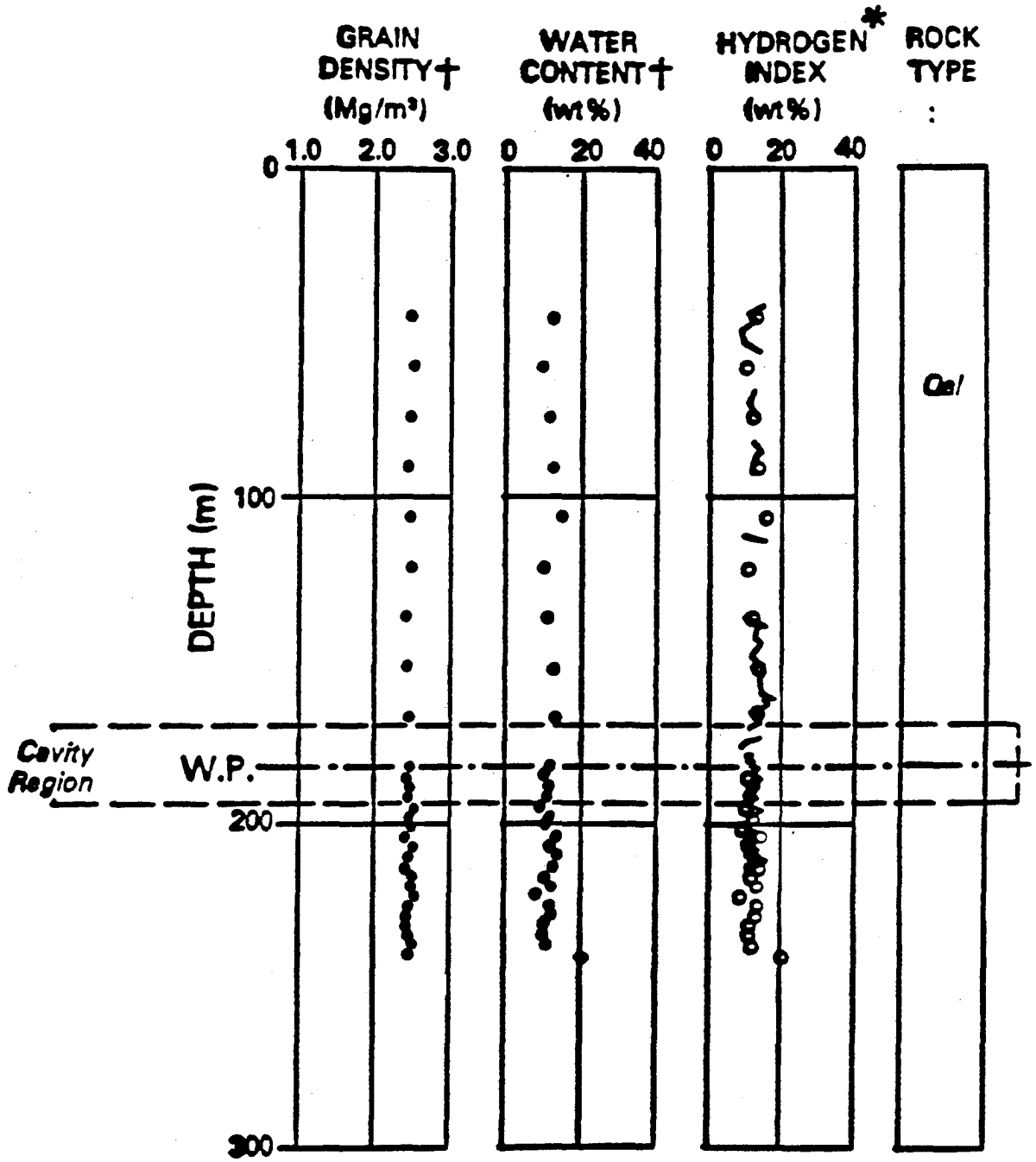
Figure 7

Since, for reasons mentioned below, there are only two sidewall samples from the cavity region, water contents were derived from the hydrogen index log (computed from the epithermal neutron and density logs - Figure 8). The averages are 12.2 wt % in the max-cred cavity region and 12.5 wt % in the overburden. This agrees well with values determined from sidewall samples taken in the same intervals.

The material properties for the medium above and within the cavity region are normal for unsaturated alluvium. Since this hole was drilled for a planned use-depth of 229 m, the original sampling plan included points on 15 m intervals throughout the zone of interest. With the assignment of NAVATA at a lesser depth, [illegible]ion gun samples were obtained to provide adequate data for characterization. Table III provides average cavity region and overburden values; Table IV provides all of the sample data. Grain densities average 2.51 Mg/m^3 and the CO_2 content is 1.4% within the cavity region. A data source summary is given in Appendix Table A-4. Histograms of Area 3 experience in unsaturated alluvium are presented in Figures 9, 10, and 11 with discrete values given in Appendix Table A-5.

No unusual or hazardous geologic characteristics were revealed; we conclude U3ib is a satisfactory location in which to execute NAVATA with complete containment.

HOLE LOGS U3lb



*Derived from epithermal neutron log. Circles represent measured samples.

†Derived from Hunt sidewall samples. Figure 8

PHYSICAL PROPERTIES SUMMARY

Hole: U31b
WP: 183 m

Event: NAVATA

	Physical Property	Depth (m)	Data Averages	Standard Deviation
1.	AVERAGE OVERBURDEN DENSITY	WP to 35.7	1.64 Mg/m^3	
2.	AVERAGE BULK DENSITY*	WP +12.2,-12.2	1.74 Mg/m^3	± 0.05
3.	AVERAGE GRAIN DENSITY**	WP +12.2,-12.2	2.51 Mg/m^3	± 0.03
4.	AVERAGE SEISMIC VELOCITY	WP to surface	1235 m/sec	
5.	AVERAGE SEISMIC VELOCITY	WP +12.2,-12.2	1524 m/sec	
6.	AVERAGE WATER CONTENT†	WP +12.2,-12.2	12.2 %	± 1.3
7.	POROSITY	WP +12.2,-12.2	40 %	
8.	SATURATION	WP +12.2,-12.2	48 %	
9.	GAS-FILLED POROSITY	WP +12.2,-12.2	21 %	
10.	AVERAGE CO_2 CONTENT††	WP +12.2,-12.2	1.4 %	
11.	DEPTHS AND PERCENT OF SWELLING CLAY: None detected			

*H_2O corrected
**Unwashed cuttings from 171 m to 183 m, and Hunt sidewall samples from 183 m to 195 m.
†From Hydrogen Index Log (11.5 from Hunt sidewall samples).
††Percussion samples 171 m to 183 m and Hunt sidewall samples from 183 m to 195 m.

TABLE IV

PHYSICAL PROPERTY DATA AS DERIVED
FROM SAMPLES AND LOGS TAKEN IN U31b

Depth (m)	Grain Density♦ (Mg/m^3)	Bulk Density* (Mg/m^3)	% H_2O♦ (wet wt)	% Porosity (calculated)	% Saturation (calculated)	% C-F Porosity (calculated)	NO_2 (dry wt)
45.7	2.47	1.63	12.9	43	49	22	2.3
61.0	2.51	1.61	10.0	42	38	26	2.4
76.2	2.48	1.58	11.8	44	43	25	1.5
91.4	2.45	1.58	13.2	44	47	23	1.2
106.7	2.47	1.64	15.4	44	58	18	1.2
121.9	2.50	1.90	10.9	32	64	12	0.7
137.2	2.44	1.61	11.7	42	45	23	1.2
152.4	2.44	1.49	13.4	47	42	27	1.4
152.4	2.42C	1.49	15.0E	48	47	26	2.9P
155.5	2.51C	1.43	16.0E	52	44	29	0.9P
158.5	2.47C	1.62	14.0E	44	52	21	1.3P
161.5	2.52C	1.62	17.0E	47	59	19	2.2P
164.6	2.52C	1.64	14.0E	44	52	21	0.5P
167.6	2.45	1.60	13.2	43	49	22	1.3
167.6	2.49C	1.60	14.0E	45	50	23	1.0P
170.7 -	2.54C	1.74	13.0E	41	56	18	1.2P
173.7	2.53C	1.71	12.0E	41	50	20	1.2P
176.8 o	2.54C	1.64	9.0E	34	49	17	0.9P
179.8 u	2.52C	1.73	11.0E	39	49	20	2.5P
182.9 v	2.49	1.68	12.2	41	50	20	1.1
WP-182.9 l	2.54C	1.68	13.0E	43	51	21	1.4P
185.9 t	2.46	1.72	13.0E	39	57	17	1.4
189.0 y	2.48	1.70	13.0E	41	54	18	1.1
192.0	2.47	1.75	12.0E	38	58	17	1.3
195.1 -	2.55	1.67	9.4	41	39	25	1.7
198.1	2.48	1.65	12.1	42	48	22	1.6
201.2	2.51	1.78	11.2	37	54	17	1.0
204.2	2.43	1.65	14.0	41	56	18	1.1
207.3	2.53	1.70	12.2	41	50	20	1.1
210.3	2.48	1.68	13.8	41	56	18	1.5
213.4	2.46	1.67	13.0	41	53	19	1.0
216.4	2.52	1.79	10.9	37	53	17	2.3
219.5	2.51	1.48	12.6	48	38	30	1.0
222.5	2.55	1.86	8.7	33	49	17	1.8
225.6	2.47	-	12.3				1.3
228.6	2.45	-	12.6				0.4
231.6	2.44	-	11.0				1.1
234.7	2.47	-	10.8				2.3
237.7	2.50	-	11.5				1.1
240.8	2.47	-	20.2				0.6

*H_2O corrected
♦Measured from Hunt sidewall samples unless otherwise noted
P Percussion gun samples
E Hydrogen Index Data
I Measured from unwashed cuttings samples

PHYSICAL PROPERTY COMPARISONS

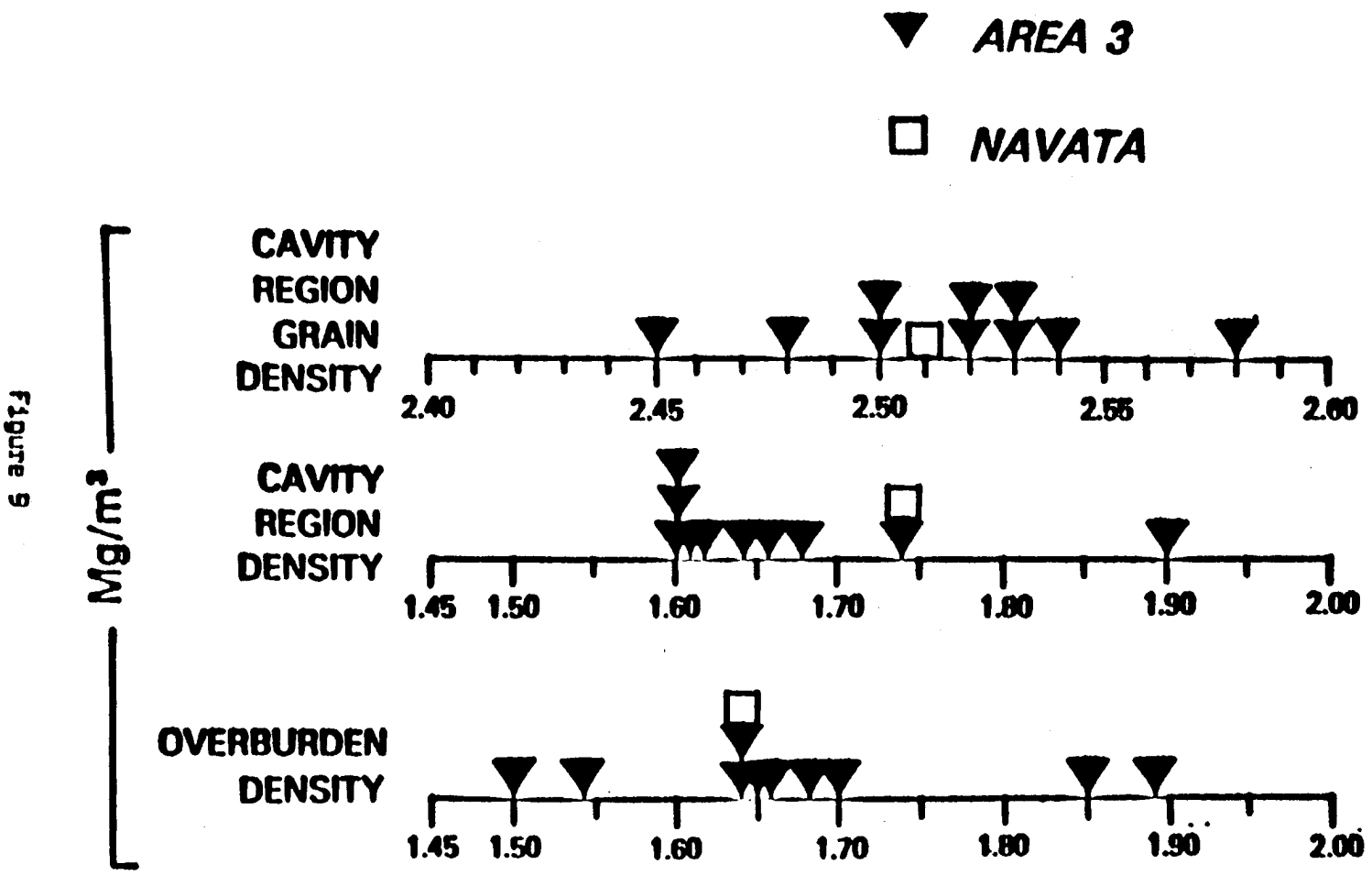


Figure 9

(continued)

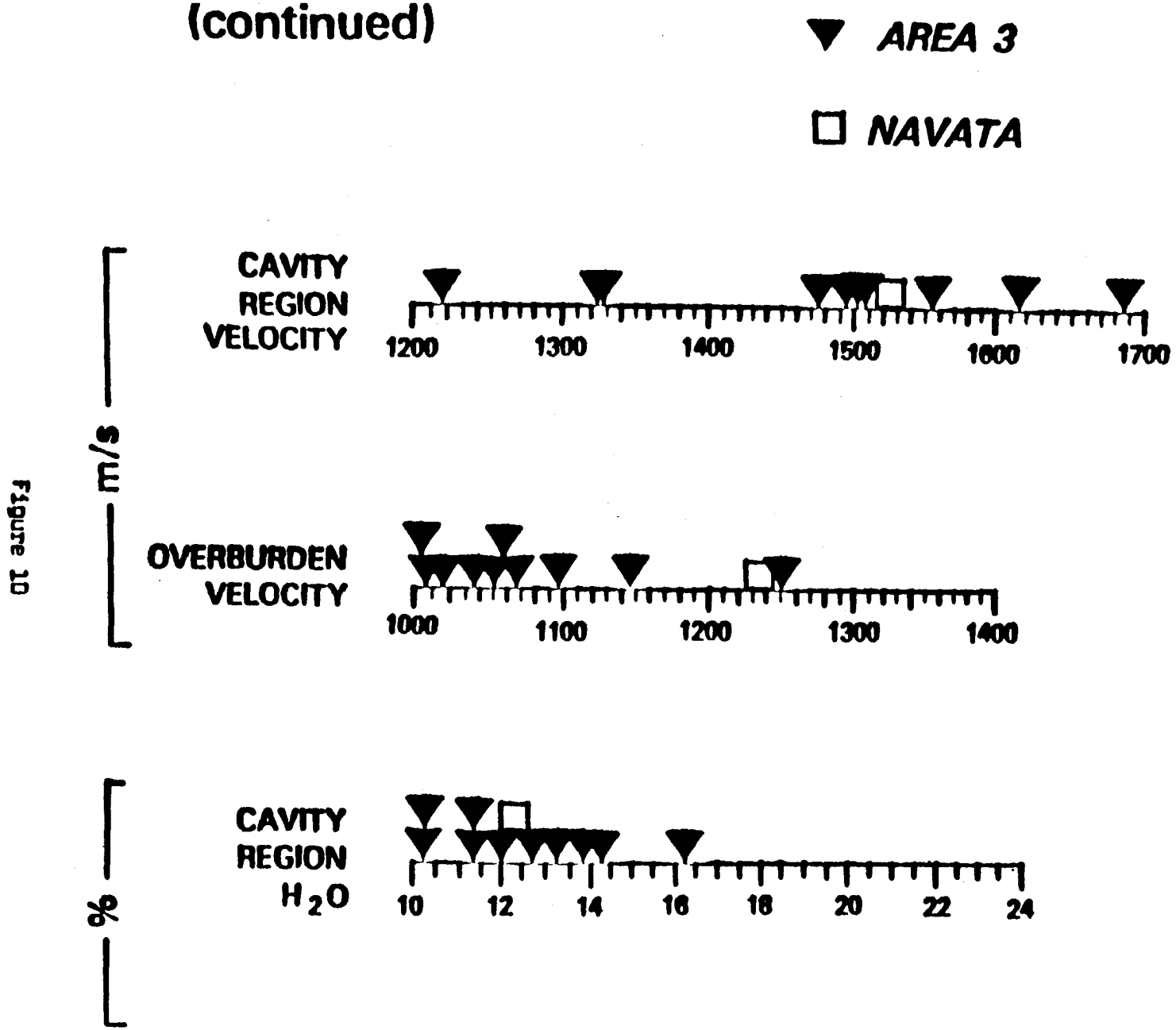


Figure 10

PHYSICAL PROPERTY COMPARISONS

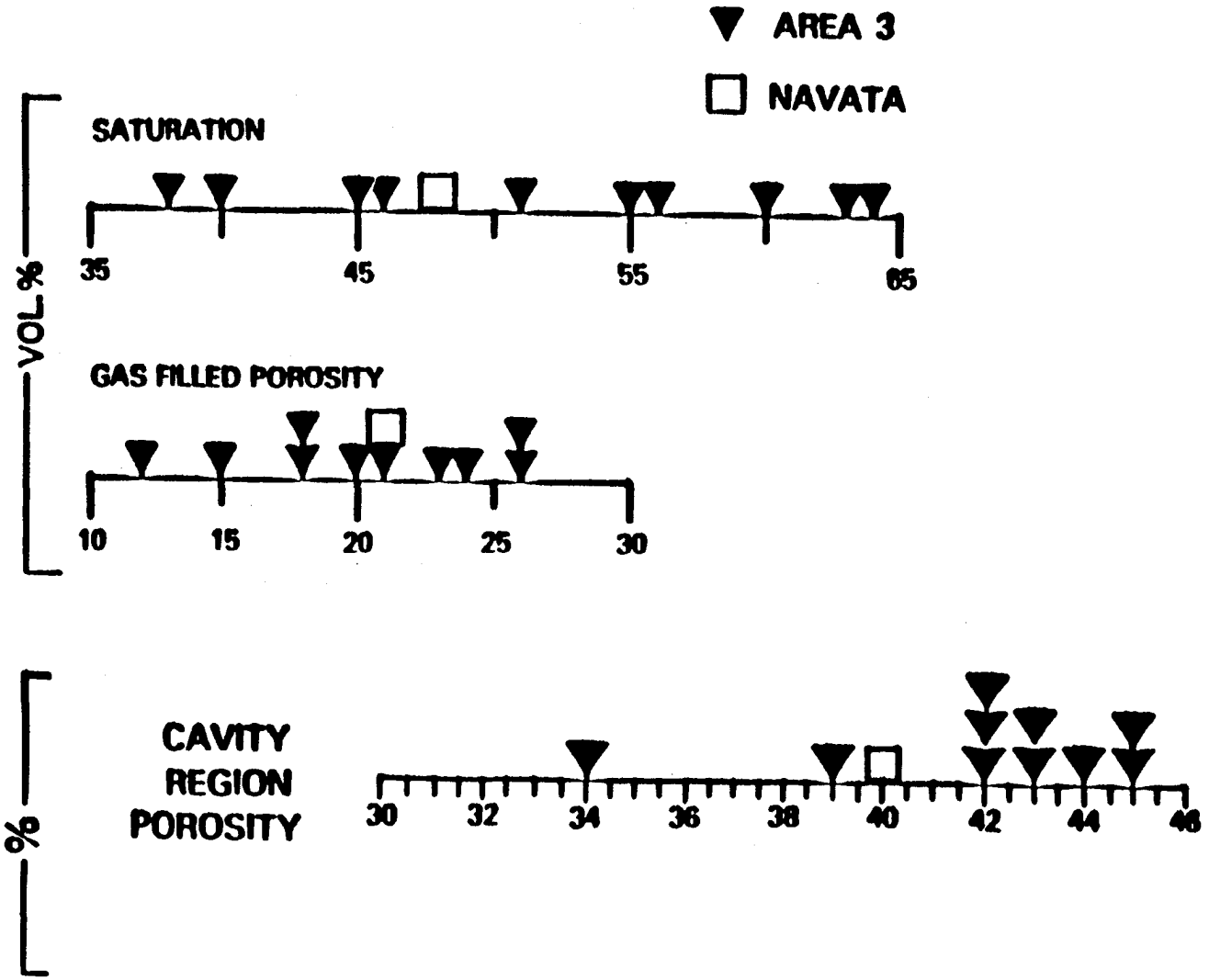


Figure 11

TABLE A-2

Lithologic Summary for U3lb Emplacement Hole
from cuttings, sidewall samples and geophysical logs

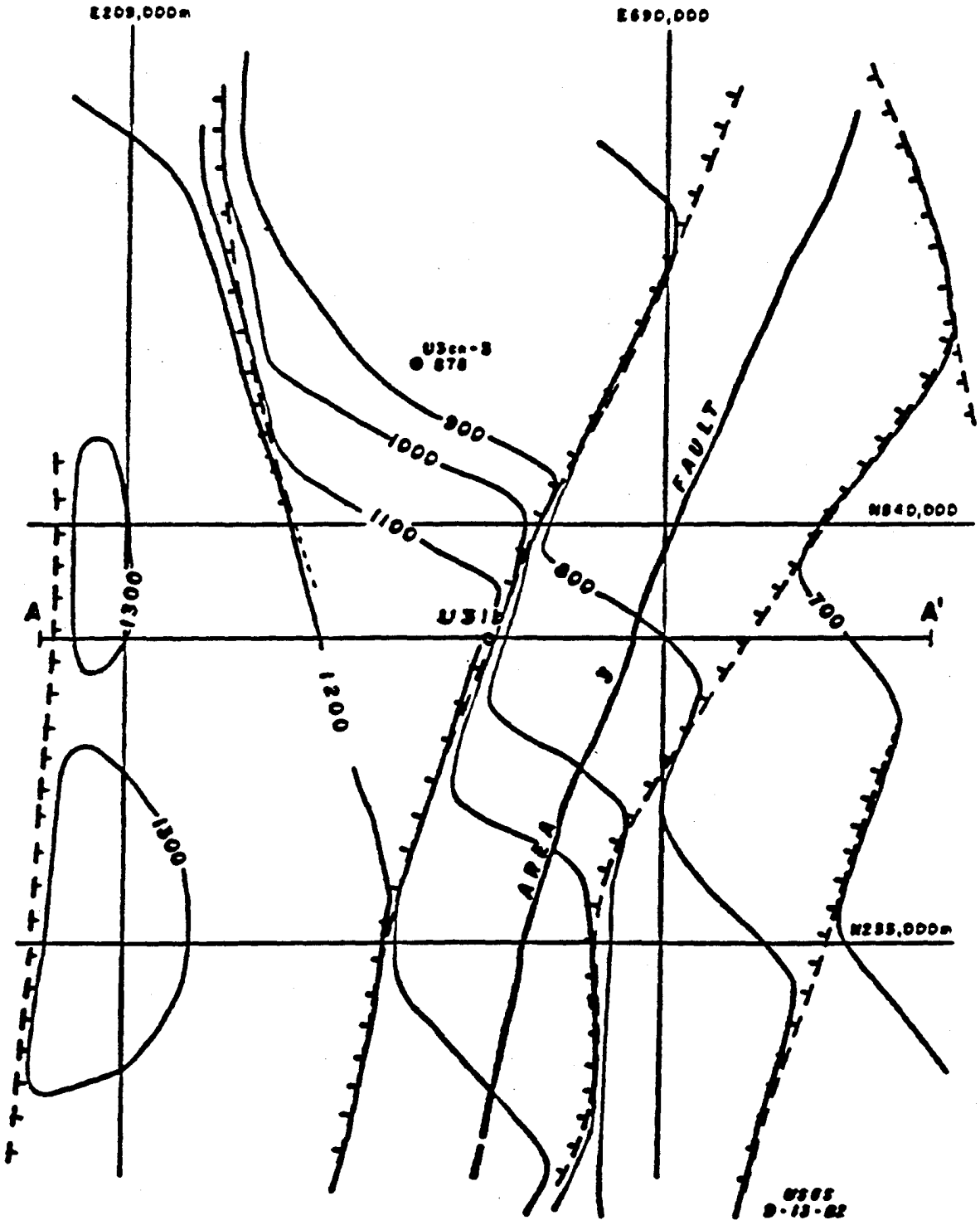
Logged by S. L. Drellack, Jr.
Fenix and Scisson, Inc.

Depth (Meters)	Lithologic Description	Stratigraphic Unit
0 - 243.8 m	Alluvium: Generally moderate-yellowish brown, some dark-yellowish-brown; tuffaceous; subangular to subrounded; poorly to moderately sorted; predominately silt to coarse sand sizes, scarce granules and small pebbles; nonindurated; scarce (<2%) Paleozoic rock fragments; slightly calcarous.	Alluvium

TABLE A-3

Lithologic Log for U3kx
Logged by Rita Romans and Susan Douglas
Fenix and Scisson, Inc.

Depth (Meters)	Lithologic Description	Stratigraphic Unit
0.0-274.3	Alluvium, fine to coarse grained sand and pebbles; medium brown, poorly indurated, tuffaceous fragments, slightly calcareous.	Alluvium
274.3-323.0	Tuff, ash-flow, non-to partially welded; pinkish gray, vitric pumice; crystal rich, quartz, chatoyant sanidine, minor sphene, biotite, sparse red biotite, sparse red lithic fragments.	Ammonia Tanks Member, Timber Mountain Tuff
323.0-374.9	Tuff, ash-flow, nonwelded; light brown, vitric; feldspar, quartz, rare chatoyant sandine, vitric pumice, biotite. Crystal content increases with depth. Interval between 348.0 - 353.6 m; Tuff, ash-flow, partially welded; pink, quartz and feldspar crystals, abundant biotite, lithic fragments.	Ammonia Tanks Member, Timber Mountain Tuff
374.9-387.0	Tuff, ash-flow, moderately to densely welded; pink to black, vitric, crystals of quartz, feldspar and biotite.	Rainier Mesa Member, Timber Mountain Tuff
387.0-408.4	Tuff, ash-flow, partially welded; pink, fine grained matrix, vapor phase crystals in pumice; crystal poor, quartz, feldspar, biotite.	Rainier Mesa Member, Timber Mountain Tuff
408.4-438.9	Tuff, ash-fall, including reworked and bedded zones and tuffaceous sandstone; zeolitized, light yellowish brown, fine grained matrix, phenocrysts include quartz, feldspar, biotite, red and black lithic fragments.	Paintbrush



Isopach map of the US1b site and vicinity
(Scale 1:12,000)

Figure A-1

ATTACHMENT B

BOREHOLE LOG SHEETS FOR U-3bl-D2

APPENDIX B
BOREHOLE LOG SHEETS FOR HOLE U-3bl-D2

LEGEND

ARCH	Archive Sample
BN	Bechtel Nevada
C	Common: although not dominant, is prevalent throughout sample
COLOR	Refer to Munsell Soil Color Chart that defines hue, value (brilliance), and chroma (purity).
D	Dominant: primary constituent in the sample
DRI	Desert Research Institute sample
HF	Huffman Laboratories, Inc. sample
LL	Lawrence Livermore National Laboratory sample
NW	Northwest Laboratory sample
P	Present: occurs regularly throughout the sample
R	Rare: occurs infrequently in the sample
USCS	Unified Soils Classification System - refer to American Society of Testing and Materials (1984) for a listing of appropriate group symbols.

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination: 45 degrees

2. CORE DATA RUN No. 1 DATE & TIME: 3/08/96, 0747 INTERVAL: 200.0-202.5 ft PENETRATION RATE: 1.00 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
200.00-200.25	7.5YR6/4		X				D	P		D	P			X				X			SM										X
200.25-200.50	7.5YR6/4		X			R	D	P		D	P				X			X			SM									X	
200.50-200.75	7.5YR6/4		X			R	D	P		D	P				X			X			SM								X		
200.75-201.00	7.5YR6/4		X				D	P		D	P			X				X			SM			X							
201.00-201.25	7.5YR6/4		X			P	D	P		D	P				X			X			SM/GM				X						
201.25-201.50	7.5YR6/4		X			R	D	P		D	P				X			X			SM					X					
201.50-201.75	7.5YR6/4		X				D	P		D	P			X				X			SM		X								
201.75-202.00	7.5YR6/4		X				D	P		D	P			X				X			SM	X									
202.00-202.25	7.5YR6/4		X			R	D	P		D	P				X			X			SM						X				
202.25-202.50	7.5YR6/4		X				D	P		D	P			X				X			SM							X			

12. COMMENTS: Started core sampling at 200.00 ft. Coarse sand and gravel subrounded. Carbonate coating on most gravels, especially 201.00-201.25 ft. which had weak carbonate cement.

13. LOGGED BY: Parsons

14. REVIEWED BY & DATE: Jill Anne Mutter 21NOV96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination:45 degrees

2. CORE DATA RUN No. 2 DATE & TIME: 3/08/96, 1539 INTERVAL: 210.0-212.5 ft PENETRATION RATE: 0.8 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DR11	ARCH	ARCH	ARCH
210.00-210.25	7.5YR6/4		X				D	P		D	P			X				X			SM										X
210.25-210.50	7.5YR6/4		X				D	P		D	P			X				X			SM									X	
210.50-210.75	7.5YR6/4		X				D	P		D	P			X				X			SM								X		
210.75-211.00	7.5YR6/4		X			P	D	P		D	P				X			X			SM/GM						X				
211.00-211.25	7.5YR6/4		X				D	P		D	P			X				X			SM							X			
211.25-211.50	7.5YR6/4		X				D	P		D	P			X				X			SM			X							
211.50-211.75	7.5YR6/4		X				D	P		D	P			X				X			SM		X								
211.75-212.00	7.5YR6/4		X				D	P		D	P			X				X			SM	X									
212.00-212.25	7.5YR6/4		X			R	D	P		D	P				X			X			SM					X					
212.25-212.50	7.5YR6/4		X			R	D	P		D	P				X			X			SM				X						

12. COMMENTS: Gravels and coarse sand are subrounded. Coarse sand dominant in 210.25-210.50 ft. Carbonate coating common on coarse grains.

13. LOGGED BY: Parsons **14. REVIEWED BY & DATE:** JuliAnne Miller 21NOV96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination:45 degrees

2. CORE DATA RUN No. 3 DATE & TIME: 3/12/96, 1413 INTERVAL: 219.0-221.5 ft PENETRATION RATE: 0.83 ft/min RECOVERY: 50%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DR11	ARCH	ARCH	ARCH
219.00-219.25	NO RECOVERY																														
219.25-219.50	NO RECOVERY																														
219.50-219.75	NO RECOVERY																														
219.75-220.00	NO RECOVERY																														
220.00-220.25	7.5YR7/4	X				C	D	P		D	P	P			X		X				GP						X				
220.25-220.50	7.5YR7/4	X				C	D	P		D	P	P			X		X				GP				X						
220.50-220.75	7.5YR7/4	X				C	D	P		D	P	P			X		X				GP			X							
220.75-221.00	7.5YR7/4	X				C	D	P		D	P	P			X		X				GP							X			
221.00-221.25	7.5YR7/4	X				C	D	P		D	P	P			X		X				GP	X									
221.25-221.50	NO RECOVERY																														

12. COMMENTS: Gravels are subrounded. No samples to HF2 and NW2. Gravels of welded tuff to 2" x 2" x 1.5"; carbonate coating on most gravels.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Payne 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination:45 degrees

2. CORE DATA RUN No. 4 DATE & TIME: 3/21/96, 1442 INTERVAL: 230.0-232.5 ft PENETRATION RATE: 0.83 ft/min RECOVERY: 90%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
230.00-230.25	NO RECOVERY																														
230.25-230.50	7.5YR6/6	X				P	D	P		D	P				X			X			SM								X		
230.50-230.75	7.5YR6/6	X				P	D	P		D	P				X			X			SM									X	
230.75-231.00	7.5YR6/6	X				P	D	R		D	P				X			X			SM/GM					X					
231.00-231.25	7.5YR6/6	X				P	D	R		D	P				X			X			SM/GM							X			
231.25-231.50	7.5YR6/6	X				P	D	R		D	P				X			X			SM/GM				X						
231.50-231.75	7.5YR6/6	X				P	D	R		D	P				X			X			SM/GM			X							
231.75-232.00	7.5YR6/6	X				P	D	R		D	P				X			X			SM/GM	X									
232.00-232.25	7.5YR6/6	X				P	D	R		D	P				X			X			SM/GM						X				
232.25-232.50	7.5YR6/6	X				P	D	R		D	P				X			X			SM/GM		X								

12. COMMENTS: Gravels are subrounded. Carbonate coatings on gravels. Decrease in fines 230.75 ft. to bottom of core.

13. LOGGED BY: Tobiason **14. REVIEWED BY & DATE:** Shannon M. Pawloski 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 5 DATE & TIME: 3/22/96, 0945 INTERVAL: 240.0-242.5 ft PENETRATION RATE: 0.5 ft/min RECOVERY: 90% +

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
240.00-240.25	7.5YR5/6		X			P	D	P		D	P	R			X			X			GM/SM										X
240.25-240.50	7.5YR5/6		X			P	D	P		D	P	R			X			X			GM/SM									X	
240.50-240.75	7.5YR5/6		X			R	D	P		D	P	R		X				X			GM/SM							X			
240.75-241.00	7.5YR5/6		X				D	P		D	P	R		X				X			GM/SM						X				
241.00-241.25	7.5YR5/6		X			R	D	P		D	P	R		X				X			GM/SM					X					
241.25-241.50	7.5YR5/6		X			R	D	P		D	P	R			X			X			GM/SM				X						
241.50-241.75	7.5YR5/6		X			P	D	P		D	P	R			X			X			GM/SM		X								
241.75-242.00	7.5YR5/6		X			R	D	P		D	P	R			X			X			GM/SM			X							
242.00-242.25	7.5YR5/6		X			R	D	P		D	P	R			X			X			GM/SM	X									
242.25-242.50	7.5YR5/6		X			R	D	P		D	P	R			X			X			GM/SM								X		

12. COMMENTS: Gravels (especially limestones) tend to be rounded. Some light carbonate coatings on grains. Bedding between coarse and fine common.

13. LOGGED BY: Parsons

14. REVIEWED BY & DATE: Julianne Hunter 21 NOV 96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 6 DATE & TIME: 3/22/96, 1355 INTERVAL: 250.0-252.5 ft PENETRATION RATE: 0.5 ft/min RECOVERY: 100%

		5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10.	11. SAMPLE DESIGNATION									
3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED	10. USCS GROUP SYMBOL	NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
250.00-250.25	7.5YR6/4		X				D	P		D	P			X				X			SM										X
250.25-250.50	7.5YR6/4		X				D	P		D	P			X				X			SM								X		
250.50-250.75	7.5YR6/4		X			R	D	P		D	P			X				X			SM					X					
250.75-251.00	7.5YR6/4		X				D	P		D	P			X				X			SM								X		
251.00-251.25	7.5YR6/4		X				D	P		D	P			X				X			SM				X						
251.25-251.50	7.5YR6/4		X			R	D	P		D	P			X				X			SM						X				
251.50-251.75	7.5YR6/4		X				D	P		D	P			X				X			SM		X								
251.75-252.00	7.5YR6/4		X			R	D	P		D	P			X				X			SM			X							
252.00-252.25	7.5YR6/4		X				D	P		D	P			X				X			SM	X									
252.25-252.50	7.5YR6/4		X				D	P		D	P			X				X			SM							X			

12. COMMENTS: Some segments (particularly from 250.75-252.00 ft.) have a weak vesicular structure. Coarser sand and small gravels typically subrounded.

13. LOGGED BY: Parsons **14. REVIEWED BY & DATE:** Julianne Winters 21 NOV 96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 7 DATE & TIME: 3/23/96, 0816 INTERVAL: 260.0-262.5 ft PENETRATION RATE: 0.8 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
260.00-260.25	7.5YR5/4		X				X			D	P			X				X			SM									X
260.25-260.50	7.5YR5/4		X			R	X			D	P			X				X			SM								X		
260.50-260.75	7.5YR5/4		X				X			D	P			X				X			SM							X			
260.75-261.00	7.5YR5/4		X				X			D	P			X				X			SM					X					
261.00-261.25	7.5YR5/4		X				X			D	P			X				X			SM				X						
261.25-261.50	7.5YR5/4		X				X			D	P			X				X			SM							X			
261.50-261.75	7.5YR5/4		X			R	X			D	P			X				X			SM			X							
261.75-262.00	7.5YR5/4		X			R	X			D	P			X				X			SM		X								
262.00-262.25	7.5YR5/4		X			R	X			D	P			X				X			SM	X									
262.25-262.50	7.5YR5/4		X				X			D	P			X				X			SM						X				

12. COMMENTS: Subrounded grains are typically gravel. Carbonate grains often coated with secondary carbonate. Core slightly overpacked.

13. LOGGED BY: Parsons

14. REVIEWED BY & DATE: Julianne Walter 21NOV96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 8 DATE & TIME: 3/25/96, 1219 INTERVAL: 270.0-272.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 80% +

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
270.00-270.25	NO RECOVERY																														
270.25-270.50	7.5YR5/6		X		R	P	D	P		D	P				X			X			GM/SM								X	
270.50-270.75	7.5YR5/6		X				D	P		D	P			X				X			SM							X		
270.75-271.00	7.5YR5/6		X				D	P		D	P			X				X			SM				X					
271.00-271.25	7.5YR5/6		X			R	D	P		D	P			X				X			SM				X					
271.25-271.50	7.5YR5/6		X				D	P		D	P			X				X			SM	X								
271.50-271.75	7.5YR5/6		X				D	P		D	P			X				X			SM						X			
271.75-272.00	7.5YR5/6		X				D	P		D	P			X				X			SM			X						
272.00-272.25	7.5YR5/6		X				D	P		D	P			X				X			SM		X							
272.25-272.50	7.5YR5/6		X				D	P		D	P			X				X			SM							X		

12. COMMENTS: Core much more powdery than previous cores. No sign of bedding (more homogenous). 271.00-271.25 ft. has powdery white smear in core (pulverized rock?). Slightly vesicular structure in some segments (very weak).

13. LOGGED BY: Parsons **14. REVIEWED BY & DATE:** Julianne Hunter 21 NOV 96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 9 DATE & TIME: 3/26/96, 0822 INTERVAL: 280.0-282.5 ft PENETRATION RATE: 1.00 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
280.00-280.25	7.5YR7/4	X				R	D	P-C		D	P			X				X			SM										
280.25-280.50	7.5YR7/4	X				R	D	P-C		D	P			X				X			SM								X		
280.50-280.75	7.5YR7/4	X				R	D	P-C		D	P			X				X			SM									X	
280.75-281.00	7.5YR7/4	X				R	D	P-C		D	P			X				X			SM										X
281.00-281.25	7.5YR7/4	X				R	D	P-C		D	P			X				X			SM					X					
281.25-281.50	7.5YR7/4	X					D	P-C		D	P			X				X			SM			X							
281.50-281.75	7.5YR7/4	X					D	P-C		D	P			X				X			SM						X				
281.75-282.00	7.5YR7/4	X					D	P-C		D	P			X				X			SM				X						
282.00-282.25	7.5YR7/4	X					D	P-C		D	P			X				X			SM		X								
282.25-282.50	7.5YR7/4	X					D	P-C		D	P			X				X			SM	X									
														X				X			SM							X			

12. COMMENTS: Few carbonate gravel clasts are subrounded to rounded. Relatively dry segments. Gravel size clasts end at 281.25 ft. Some coarse sand in segment 280.50-280.75 ft. Well sorted in terms of grains larger than fine sand rare throughout. No vesicular structure noted.

13. LOGGED BY: Tobiason **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 10 DATE & TIME: 3/26/96, 1247 INTERVAL: 290.0-292.5 ft PENETRATION RATE: 0.6 ft/min RECOVERY: 80% +

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
290.00-290.25	NO RECOVERY																														
290.25-290.50	7.5YR7/4	X				R	D	P		D	P			X				X			SM								X		
290.50-290.75	7.5YR7/4	X				R	D	P		D	P			X				X			SM							X			
290.75-291.00	7.5YR7/4	X				R	D	P		D	P			X				X			SM			X							
291.00-291.25	7.5YR7/4	X				R	D	P		D	P			X				X			SM		X								
291.25-291.50	7.5YR7/4	X				R	D	P		D	P			X				X			SM						X				
291.50-291.75	7.5YR7/4	X				R	D	P		D	P			X				X			SM	X									
291.75-292.00	7.5YR7/4	X				R	D	P		D	P			X				X			SM				X						
292.00-292.25	7.5YR7/4	X				R	D	P		D	P			X				X			SM					X					
292.25-292.50	7.5YR7/4	X				R	D	P		D	P			X				X			SM									X	

12. COMMENTS: Gravels are subrounded with carbonate coatings. Larger gravels, ~0.5", are more rounded. Possible weak vesicular structure throughout.

13. LOGGED BY: Toblason **14. REVIEWED BY & DATE:** Shannon M. Parsons

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 11 DATE & TIME: 3/26/96, 1558 INTERVAL: 300.0-302.5 ft PENETRATION RATE: 0.8 ft/min RECOVERY: 80%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
300.00-300.25	NO RECOVERY (FILL)																														
300.25-300.50	NO RECOVERY (FILL)																														
300.50-300.75	7.5YR7/4	X				R	D	P		D	P			X			X				SM								X		
300.75-301.00	7.5YR7/4	X				R	D	P		D	P			X			X				SM			X							
301.00-301.25	7.5YR7/4	X				R	D	P		D	P			X			X				SM						X				
301.25-301.50	7.5YR7/4	X				R	D	P		D	P			X			X				SM				X						
301.50-301.75	7.5YR7/4	X				R	D	P		D	P			X			X				SM					X					
301.75-302.00	7.5YR7/4	X				R	D	P		D	P			X			X				SM	X									
302.00-302.25	7.5YR7/4	X				R	D	P		D	P			X			X				SM		X								
302.25-302.50	7.5YR7/4	X				R	D	P		D	P			X			X				SM							X			

12. COMMENTS: Gravels are subrounded to rounded with carbonate coating. Possible weak vesicular structure throughout.

13. LOGGED BY: Tobiason **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 12 DATE & TIME: 3/27/96, 0918 INTERVAL: 310.0-312.5 ft PENETRATION RATE: 0.8 ft/min RECOVERY: 90% +

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
310.00-310.25	NO RECOVERY (FILL)																														
310.25-310.50	7.5YR7/4	X				R	D	P		D	P			X				X			SM								ARCH		
310.50-310.75	7.5YR7/4	X				R	D	P		D	P			X				X			SM							DRI1			
310.75-311.00	7.5YR7/4	X				R	D	P		D	P			X				X			SM						LL				
311.00-311.25	7.5YR7/4	X				R	D	P		D	P			X				X			SM				HF1						
311.25-311.50	7.5YR7/4	X				R	D	P		D	P			X				X			SM			BN1							
311.50-311.75	7.5YR7/4	X				R	D	P		D	P			X				X			SM					HF2					
311.75-312.00	7.5YR7/4	X				R	D	P		D	P			X				X			SM		NW2								
312.00-312.25	7.5YR7/4	X				R	D	P		D	P			X				X			SM	NW1									
312.25-312.50	7.5YR7/4	X				R	D	P		D	P			X				X			SM									ARCH	

12. COMMENTS: Gravels are subrounded to rounded with carbonate coating. Small pocket of coarse to very coarse sand observed in 310.25-310.50 ft. segment.

Weak vesicular structure throughout.

13. LOGGED BY: Tobiason **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 13 DATE & TIME: 3/28/96, 0744 INTERVAL: 320.0-322.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 80%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
320.00-320.25	NO RECOVERY																														
320.25-320.50	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW								X		
320.50-320.75	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW							X			
320.75-321.00	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW					X					
321.00-321.25	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW			X							
321.25-321.50	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW				X						
321.50-321.75	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW	X									
321.75-322.00	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW		X								
322.00-322.25	7.5YR5-6/6	X				P	D	R		D	P				X			X			GW/SW						X				
322.25-322.50	SAMPLE LOST NO RECOVERY																														

12. COMMENTS: Bottom segment lost due to jolting caused by extreme difficulty in unscrewing core drive shoe. Sample is much more coarse than previous cores.

Maximum grain size ~2". Carbonate gravels subrounded. Tuff clasts angular-subangular. Near absence of silt/clay. Small biotite fragments in 321.00-321.25 ft. segment. Possible vesicular structure throughout.

13. LOGGED BY: Tobiason **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 14 DATE & TIME: 3/28/96, 1129 INTERVAL: 330.0-332.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 90%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
330.00-330.25	NO RECOVERY (FILL)																														
330.25-330.50	7.5YR6/6	X				R	D	R		D	P			X				X			SP						X				
330.50-330.75	7.5YR6/6	X				R	D	R		D	P			X				X			SP					X					
330.75-331.00	7.5YR6/6	X				R	D	R		D	P			X				X			SP								X		
331.00-331.25	7.5YR6/6	X				R	D	R		D	P			X				X			SP			X							
331.25-331.50	7.5YR6/6	X				R	D	R		D	P			X				X			SP				X						
331.50-331.75	7.5YR6/6	X				R	D	R		D	P			X				X			SP	X									
331.75-332.00	7.5YR6/6	X				R	D	R		D	P			X				X			SP		X								
332.00-332.25	7.5YR6/6	X				R	D	R		D	P			X				X			SP							X			
332.25-332.50	7.5YR6/6	X				R	D	R		D	P			X				X			SP									X	

12. COMMENTS: Rare carbonate gravels subrounded to rounded. Mainly sand size. Finer material than previous core. No vesicular structure noted.

13. LOGGED BY: Tobiason **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 15 DATE & TIME: 3/29/96, 0743 INTERVAL: 340.0-342.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 90% +

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DR11	ARCH	ARCH	ARCH
340.00-340.25	7.5YR6/4		X			P	D	R		D	P	R			X			X			GW							X			
340.25-340.50	7.5YR6/4		X			C	D	R		D	P	R			X			X			GW						X				
340.50-340.75	7.5YR6/4		X			C	D	R		D	P	R			X			X			GW					X					
340.75-341.00	7.5YR6/6		X			C	D	R		D	P	R			X			X			GW				X						
341.00-341.25	7.5YR6/6		X			C	D	R		D	P	R			X			X			GW			X							
341.25-341.50	7.5YR6/6		X			C	D	R		D	P	R			X			X			GW		X								
341.50-341.75	7.5YR6/6		X			C	D	R		D	P	R			X			X			GW								X		
341.75-342.00	7.5YR6/6		X			C	D	R		D	P	R			X			X			GW									X	
342.00-342.25	7.5YR6/6		X			C	D	R		D	P	R			X			X			GW	X									
342.25-342.50	7.5YR6/6		X			C	D	R		D	P	R			X			X			GW										X

12. COMMENTS: Gravels are subrounded. Gravels coarsen from 340.50-341.50 ft. then become finer. Carbonate coating on gravels and weak cement; sands are coarse. No vesicular structure noted. Gravel max = 2" x 1" x 1.5". 342.25-342.50 ft. - partial core.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 16 DATE & TIME: 3/29/96, 1107 INTERVAL: 350.0-352.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 90%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
350.00-350.25	NO RECOVERY																														
350.25-350.50	7.5YR6/6	X				P	D	P		D	P	R			X		X				SP								X		
350.50-350.75	7.5YR6/6	X				P	D	P		D	P	R			X		X				SP									X	
350.75-351.00	7.5YR6/6	X				P	D	P		D	P	R			X		X				SP						X				
351.00-351.25	7.5YR6/6	X				P	D	P		D	P	R			X		X				SP							X			
351.25-351.50	7.5YR6/6	X				R	D	P		D	P	R			X		X				SP				X						
351.50-351.75	7.5YR6/6	X				R	D	P		D	P	R			X		X				SP			X							
351.75-352.00	7.5YR6/6	X					D	P		D	P	R		X			X				SP		X								
352.00-352.25	7.5YR6/6	X					D	P		D	P	R		X			X				SP	X									
352.25-352.50	7.5YR6/6	X					D	P		D	P	R		X			X				SP					X					

12. COMMENTS: Gravels are subrounded; weak cement; no vesicular structure.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Tatum 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 17 DATE & TIME: 3/29/96, 1530 INTERVAL: 360.0-362.5 ft PENETRATION RATE: 0.625 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
360.00-360.25	7.5YR6/6	X					D	P		D	P	R		X				X			SM								X		
360.25-360.50	7.5YR6/6	X				R	D	P		D	P	R			X			X			SM									X	
360.50-360.75	7.5YR6/6	X				R	D	P		D	P	R			X			X			SM						X				
360.75-361.00	7.5YR6/6	X				P	D	P		D	P	R				X		X			GM										X
361.00-361.25	7.5YR6/6	X				P	D	P		D	P	R			X			X			SM							X			
361.25-361.50	7.5YR6/6	X				P	D	P		D	P	R			X			X			SM					X					
361.50-361.75	7.5YR6/6	X				P	D	P		D	P	R			X			X			SM			X							
361.75-362.00	7.5YR6/6	X				P	D	P		D	P	R			X			X			SM		X								
362.00-362.25	7.5YR6/6	X				P	D	P		D	P	R			X			X			SM	X									
362.25-362.50	7.5YR6/6	X				P	D	P		D	P	R			X			X			SM				X						

12. COMMENTS: Core overpacked; large gravel in 360.75-361.00 ft. = 3" x 1.5" x ?". Gravels are subrounded; weak carbonate cement.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 18 DATE & TIME: 3/30/96, 0914 INTERVAL: 370.0-372.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 80%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
370.00-370.25	NO RECOVERY																														
370.25-370.50	NO RECOVERY																														
370.50-370.75	7.5YR6/6	X				R	D	P		D	P			X			X				SM								X		
370.75-371.00	7.5YR6/6	X					D	P		D	P			X			X				SM						X				
371.00-371.25	7.5YR6/6	X					D	P		D	P			X			X				SM							X			
371.25-371.50	7.5YR6/6	X					D	P		D	P			X			X				SM					X					
371.50-371.75	7.5YR6/6	X				R	D	P		D	P			X			X				SM				X						
371.75-372.00	7.5YR6/6	X				R	D	P		D	P			X			X				SM			X							
372.00-372.25	7.5YR6/6	X					D	P		D	P			X			X				SM	X									
372.25-372.50	7.5YR6/6	X					D	P		D	P			X			X				SM		X								

12. COMMENTS: Due to excessive force to open barrel entire core is fractured, and core lost in first two sections. Gravels are subrounded.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Tavana 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 19 DATE & TIME: 3/30/96, 1319 INTERVAL: 380.0-382.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 90%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
380.00-380.25	NO RECOVERY																														
380.25-380.50	7.5YR7/6	X					D	P		D	P			X			X				SM								X		
380.50-380.75	7.5YR7/6	X				R	D	P		D	P			X			X				SM	X									
380.75-381.00	7.5YR7/6	X					D	P		D	P			X			X				SM		X								
381.00-381.25	7.5YR7/6	X					D	P		D	P			X			X				SM			X							
381.25-381.50	7.5YR7/6	X					D	P		D	P			X			X				SM				X						
381.50-381.75	7.5YR7/6	X					D	P		D	P			X			X				SM					X					
381.75-382.00	7.5YR7/6	X					D	P		D	P			X			X				SM							X			
382.00-382.25	7.5YR7/6	X				R	D	P		D	P			X			X				SM						X				
382.25-382.50	7.5YR7/6	X				R	D	P		D	P			X			X				SM								X		

12. COMMENTS: Weak to moderate carbonate cement in 380.25-380.50 ft.; carbonate cement visible (very weak) in other sections. Gravels are subrounded.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Tarver 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 20 DATE & TIME: 4/01/96, 0904 INTERVAL: 390.0-392.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
390.00-390.25	7.5YR5/6	X					D	P		D	P	?		X				X			SM										X
390.25-390.50	7.5YR5/6	X					D	P		D	P	?		X				X			SM									X	
390.50-390.75	7.5YR5/6	X					D	P		D	P	?		X				X			SM					X					
390.75-391.00	7.5YR5/6	X				R	D	P		D	P	?			X			X			SM							X			
391.00-391.25	7.5YR5/6	X				R	D	P		D	P	?			X			X			SM				X						
391.25-391.50	7.5YR5/6	X				R	D	P		D	P	?			X			X			SM			X							
391.50-391.75	7.5YR5/6	X				R	D	P		D	P	?			X			X			SM								X		
391.75-392.00	7.5YR5/6	X					D	P		D	P	?		X				X			SM	X									
392.00-392.25	7.5YR5/6	X				R	D	P		D	P	?			X			X			SM		X								
392.25-392.50	7.5YR5/6	X				R	D	P		D	P	?			X			X			SM						X				

12. COMMENTS: Core slightly overcompacted. Carbonate lenses common in most core segments. Weak cement in more coarse areas of cores. Segment 391.50-391.75 ft. has black powder in a very small pocket at top, hydraulic fluid?, (black tar-like flecks) in upper cores.

13. LOGGED BY: Parsons **14. REVIEWED BY & DATE:** JuLeanne Hutter 21 NOV 96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 21 DATE & TIME: 4/01/96, 1305 INTERVAL: 400.0-402.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
400.00-400.25	7.5YR6/4		X				D	P		D	P	P		X				X			SM										X
400.25-400.50	7.5YR6/4		X				D	P		D	P	P		X				X			SM									X	
400.50-400.75	7.5YR6/4		X				D	P		D	P	P		X				X			SM								X		
400.75-401.00	7.5YR6/4		X				D	P		D	P	P		X				X			SM							X			
401.00-401.25	7.5YR6/4		X				D	P		D	P	P		X				X			SM				X						
401.25-401.50	7.5YR6/4		X				D	P		D	P	P		X				X			SM					X					
401.50-401.75	7.5YR6/4		X			R	D	P		D	P	P		X				X			SM		X								
401.75-402.00	7.5YR6/4		X				D	P		D	P	P		X				X			SM	X									
402.00-402.25	7.5YR6/4		X				D	P		D	P	P		X				X			SM			X							
402.25-402.50	7.5YR6/4		X				D	P		D	P	P		X				X			SM						X				

12. COMMENTS: Core compacted. Coarse sand dominant. Weak carbonate cement common, weak carbonate lenses present in most core segments.

13. LOGGED BY: Parsons

14. REVIEWED BY & DATE: JuliAnne Hutter 21NOV96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 22 DATE & TIME: 4/01/96, 1625 INTERVAL: 410.0-412.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 100%

		5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7: LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
410.00-410.25	7.5YR6/4	X					D	P		D	P			X				X			SM									X
410.25-410.50	7.5YR6/4	X					D	P		D	P			X				X			SM								X	
410.50-410.75	7.5YR6/4	X					D	P		D	P			X				X			SM							X		
410.75-411.00	7.5YR6/4	X					D	P		D	P			X				X			SM					X				
411.00-411.25	7.5YR6/4	X					D	P		D	P			X				X			SM				X					
411.25-411.50	7.5YR6/4	X					D	P		D	P			X				X			SM						X			
411.50-411.75	7.5YR6/4	X					D	P		D	P			X				X			SM			X						
411.75-412.00	7.5YR6/4	X					D	P		D	P			X				X			SM	X								
412.00-412.25	7.5YR6/4	X					D	P		D	P			X				X			SM		X							
412.25-412.50	7.5YR6/4	X					D	P		D	P			X				X			SM							X		

12. COMMENTS: Core compacted. Weak carbonate cement in 411.75-412.00 ft.

13. LOGGED BY: Parsons

14. REVIEWED BY & DATE: JoAnne Wolfe 21NOV96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 23 DATE & TIME: 4/02/96, 0910 INTERVAL: 420.0-422.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
420.00-420.25	7.5YR6/6	X				P	D	P		D	P				X			X			SM								X		
420.25-420.50	7.5YR6/6	X				P	D	P		D	P				X			X			SM					X					
420.50-420.75	7.5YR6/6	X				P	D	P		D	P				X			X			SM				X						
420.75-421.00	7.5YR6/6	X				P	D	P		D	P				X			X			SM						X				
421.00-421.25	7.5YR6/4	X				P	D	P		D	P				X			X			SM							X			
421.25-421.50	7.5YR6/4	X				R	D	P		D	P			X				X			SM	X									
421.50-421.75	7.5YR6/4	X				R	D	P		D	P			X				X			SM		X								
421.75-422.00	7.5YR6/4	X				R	D	P		D	P			X				X			SM			X							
422.00-422.25	7.5YR6/4	X				R	D	P		D	P			X				X			SM								X		
422.25-422.50	7.5YR6/4	X				R	D	P		D	P			X				X			SM										X

12. COMMENTS: Gravels are subrounded. Weak cement in 420.00-421.00 ft. Gravel content decreases with depth.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon Mi Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 24 DATE & TIME: 4/02/96, 1305 INTERVAL: 430.0-432.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
430.00-430.25	7.5YR6/3	X					D	P		D	P			X			X				SM								X	
430.25-430.50	7.5YR6/3	X					D	P		D	P			X			X				SM									X
430.50-430.75	7.5YR6/3	X				P	D	P		D	P				X		X				SM/SP							X		
430.75-431.00	7.5YR6/3	X				P	D	P		D	P				X		X				SM/SP						X			
431.00-431.25	7.5YR6/3	X				P	D	P		D	P				X		X				SM/SP					X				
431.25-431.50	7.5YR6/3	X				P	D	P		D	P				X		X				SM/SP				X					
431.50-431.75	7.5YR6/4	X				P	D	P		D	P				X		X				SM/SP			X						
431.75-432.00	7.5YR6/4	X				P	D	P		D	P				X		X				SM/SP		X							
432.00-432.25	7.5YR6/4	X				R	D	P		D	P			X			X				SM	X								
432.25-432.50	7.5YR6/4	X					D	P		D	P			X			X				SM								X	

12. COMMENTS: Core overpacked. Coarse sand grades into fine then coarser gravel. Carbonate cement visible throughout. Weak cement formed in 431.50-432.50 ft.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 25 DATE & TIME: 4/03/96, 0749 INTERVAL: 440.0-442.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 80% +

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
440.00-440.25	NO RECOVERY																														
440.25-440.50	7.5YR6/6	X				R	D	P		D	P	R			X			X			SM								X	
440.50-440.75	7.5YR6/6	X					D	P		D	P	R		X			X				SM							X		
440.75-441.00	7.5YR6/6	X					D	P		D	P	R		X			X				SM									
441.00-441.25	7.5YR6/6	X					D	P		D	P	R		X			X				SM									
441.25-441.50	7.5YR6/6	X					D	P		D	P	R		X			X				SM									
441.50-441.75	7.5YR6/6	X					D	P		D	P	R		X			X				SM									
441.75-442.00	7.5YR6/6	X				R	D	P		D	P	R			X			X			SM									
442.00-442.25	7.5YR6/6	X				R	D	P		D	P	R			X			X			SM									
442.25-442.50	7.5YR6/6	X					D	P		D	P	R			X			X			SM									

12. COMMENTS: Coarse sand grades in and out through core in beds. Core 442.00-442.25 ft. is 90% coarse sand; 442.25-442.50 ft. has a layer of coarse sand then sand size decreases. Carbonate cement visible within 441.00-442.50 ft. 440.25-440.50 ft. - partial core.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG: Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD:ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 26 DATE & TIME: 4/03/96, 1226 INTERVAL: 450.0-452.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
450.00-450.25	7.5YR6/4	X					D	P		D	P			X			X				SM										X
450.25-450.50	7.5YR6/4	X					D	P		D	P			X			X				SM									X	
450.50-450.75	7.5YR6/4	X					D	P		D	P			X			X				SM								X		
450.75-451.00	7.5YR6/4	X					D	P		D	P			X			X				SM							X			
451.00-451.25	7.5YR6/4	X					D	P		D	P			X			X				SM						X				
451.25-451.50	7.5YR6/4	X					D	P		D	P			X			X				SM					X					
451.50-451.75	7.5YR6/4	X					D	P		D	P			X			X				SM				X						
451.75-452.00	7.5YR6/4	X					D	P		D	P			X			X				SM			X							
452.00-452.25	7.5YR6/4	X					D	P		D	P			X			X				SM		X								
452.25-452.50	7.5YR6/4	X					D	P		D	P			X			X				SM	X									

12. COMMENTS: Coarse sands interspersed throughout core. Carbonate cement visible throughout core.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG: Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD:ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 27 DATE & TIME: 4/03/96, 1541 INTERVAL: 460.0-462.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 90% +

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
460.00-460.25	7.5YR6/4	X				R	D	R		D	P			X				X			SM									X
460.25-460.50	7.5YR6/4	X					D	R		D	P			X			X				SM								X		
460.50-460.75	7.5YR6/4	X					D	R		D	P			X			X				SM							X			
460.75-461.00	7.5YR6/4	X					D	R		D	P			X			X				SM						X				
461.00-461.25	7.5YR6/4	X					D	R		D	P			X			X				SM					X					
461.25-461.50	7.5YR6/4	X					D	R		D	P			X			X				SM				X						
461.50-461.75	7.5YR6/4	X					D	R		D	P			X			X				SM			X							
461.75-462.00	7.5YR6/4	X					D	R		D	P			X			X				SM		X								
462.00-462.25	7.5YR6/4	X					D	R		D	P			X			X				SM	X									
462.25-462.50	7.5YR6/4	X					D	R		D	P			X			X				SM								X		

12. COMMENTS: Gravels are subrounded. 460.00-460.25 ft. and 462.25-462.50 ft. - partial cores.

13. LOGGED BY: Miller **14. REVIEWED BY & DATE:** Shannon M. Parsons 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG: Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD:ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 28 DATE & TIME: 4/04/96, 1442 INTERVAL: 470.0-472.5 ft PENETRATION RATE: 0.6 ft/min RECOVERY: 100%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
470.00-470.25	7.5YR6/4	X				P	D	R		D	P			X			X				SM								X		
470.25-470.50	7.5YR6/4	X				P	D	R		D	P			X			X				SM									X	
470.50-470.75	7.5YR6/4	X				P	D	R		D	P			X			X				SM										X
470.75-471.00	7.5YR6/4	X				P	D	R		D	P			X			X				SM							X			
471.00-471.25	7.5YR6/4	X				P	D	R		D	P			X			X				SM						X				
471.25-471.50	7.5YR6/6	X				R	D	R		D	P			X			X				SM				X						
471.50-471.75	7.5YR6/6	X				R	D	R		D	P			X			X				SM			X							
471.75-472.00	7.5YR6/6	X				R	D	R		D	P			X			X				SM	X									
472.00-472.25	7.5YR6/6	X				R	D	R		D	P			X			X				SM		X								
472.25-472.50	7.5YR6/6	X				R	D	R		D	P			X			X				SM					X					

12. COMMENTS: Gravels are subrounded.

13. LOGGED BY: Tobiason

14. REVIEWED BY & DATE: Deanna M. Tessens 11/21/96

BOREHOLE LOG SHEET FOR ALLUVIAL CORE SAMPLES

1. BOREHOLE DATA DESIGNATION: U-3bl-D2 RIG: Tonto Rig 12; Ingersoll Rand T-4 DRILL METHOD:ODEX Casing Advance Underreaming Inclination 45 degrees

2. CORE DATA RUN No. 29 DATE & TIME: 4/05/96, 0751 INTERVAL: 480.0-482.5 ft PENETRATION RATE: 1.25 ft/min RECOVERY: 90%

3. DEPTH (ft)	4. COLOR (MUNSELL CHART)	5. MOISTURE CONTENT			6. PARTICLE SIZE DISTRIBUTION				7. LITHOLOGY					8. SORTING			9. GRAIN SHAPE				10. USCS GROUP SYMBOL	11. SAMPLE DESIGNATION									
		DRY	MOIST	WET	COBBLES	GRAVEL	SAND	SILT-CLAY	BASALT	TUFF	CARBONATES	SILICICLASTICS	OTHER	WELL	MODERATE	POOR	ANGULAR	SUBANGULAR	SUBROUNDED	ROUNDED		NW1	NW2	BN1	HF1	HF2	LL	DRI1	ARCH	ARCH	ARCH
480.00-480.25	NO RECOVERY (FILL)																														
480.25-480.50	7.5YR6/6	X				P	D	R		D	P				X			X			SM								X	
480.50-480.75	7.5YR6/6	X				R	D	R		D	P			X				X			SM									X
480.75-481.00	7.5YR6/6	X				R	D	R		D	P			X				X			SM							X		
481.00-481.25	7.5YR6/6	X				R	D	R		D	P			X				X			SM				X					
481.25-481.50	7.5YR6/6	X				R	D	R		D	P			X				X			SM						X			
481.50-481.75	7.5YR6/6	X				R	D	R		D	P			X				X			SM	X								
481.75-482.00	7.5YR6/6	X				P	D	R		D	P				X			X			SM		X							
482.00-482.25	7.5YR6/6	X				P	D	R		D	P				X			X			SM			X						
482.25-482.50	7.5YR6/6	X				P	D	R		D	P				X			X			SM					X				

12. COMMENTS: 480.25-480.50 ft. mostly fill material. 481.75-482.50 ft. shows increase in gravels. Mainly carbonate gravels - subrounded with rare tuff gravel, subangular.

13. LOGGED BY: Tobiason **14. REVIEWED BY & DATE:** Shannon M. Tuoma 11/21/96

ATTACHMENT C

CHARACTERIZATION DATA FIGURES

FOR BOREHOLE U-3bl-D2

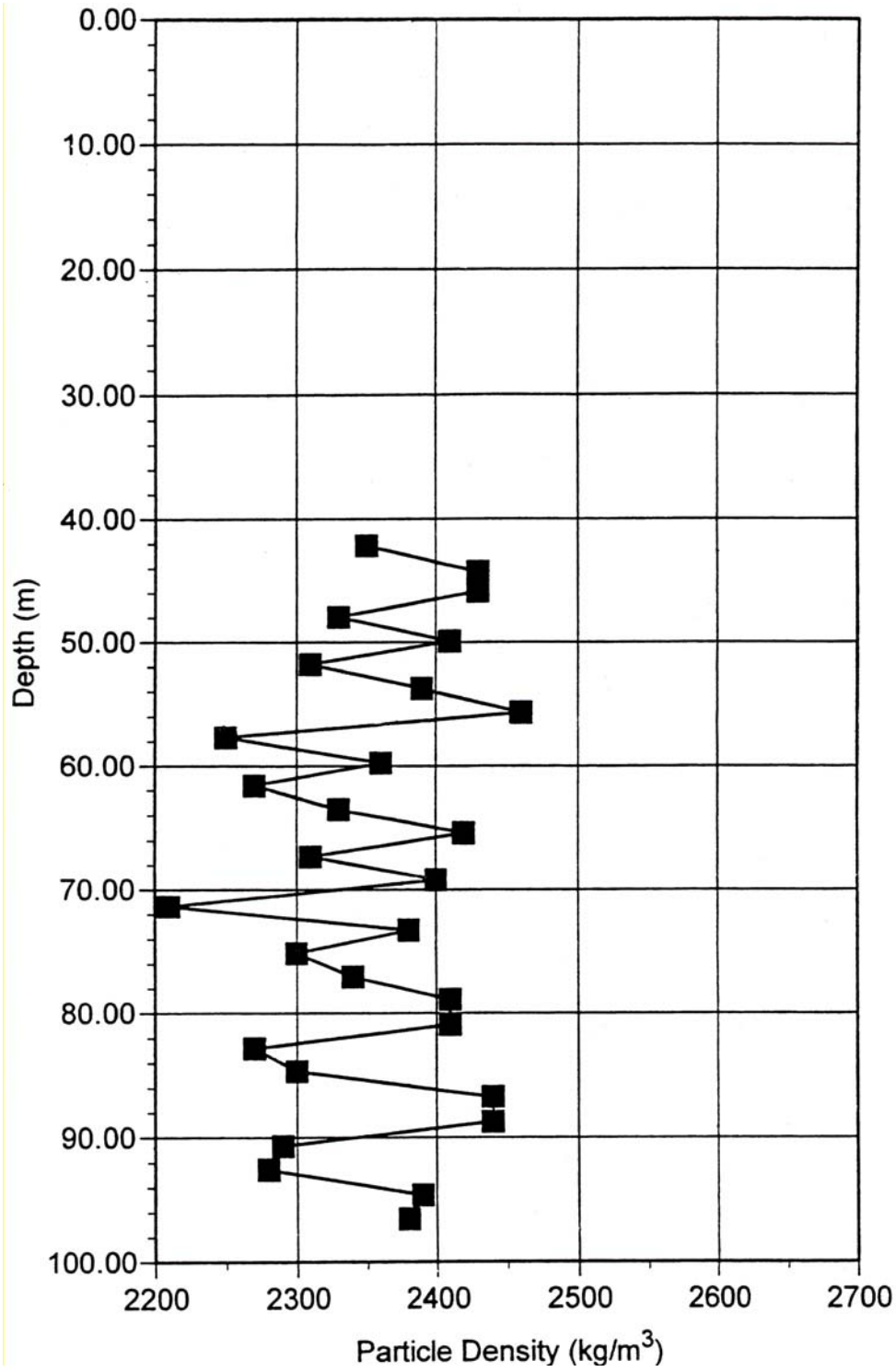


Figure C-1
Particle Density versus Depth for U-3bl-D2
(In kilograms per cubic meter**)**

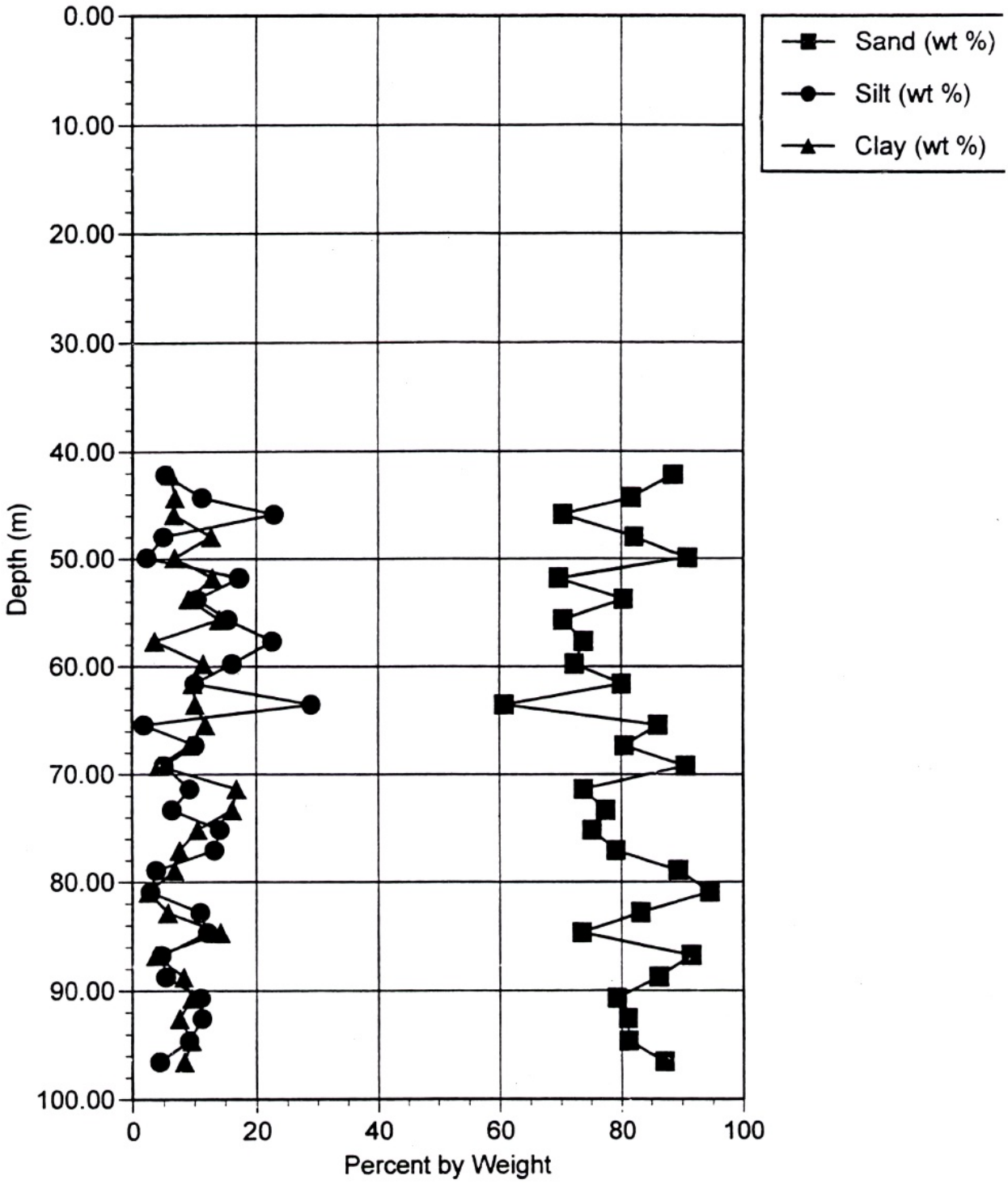


Figure C-2
Sand, Silt, and Clay Fractions versus Depth for U-3bl-D2

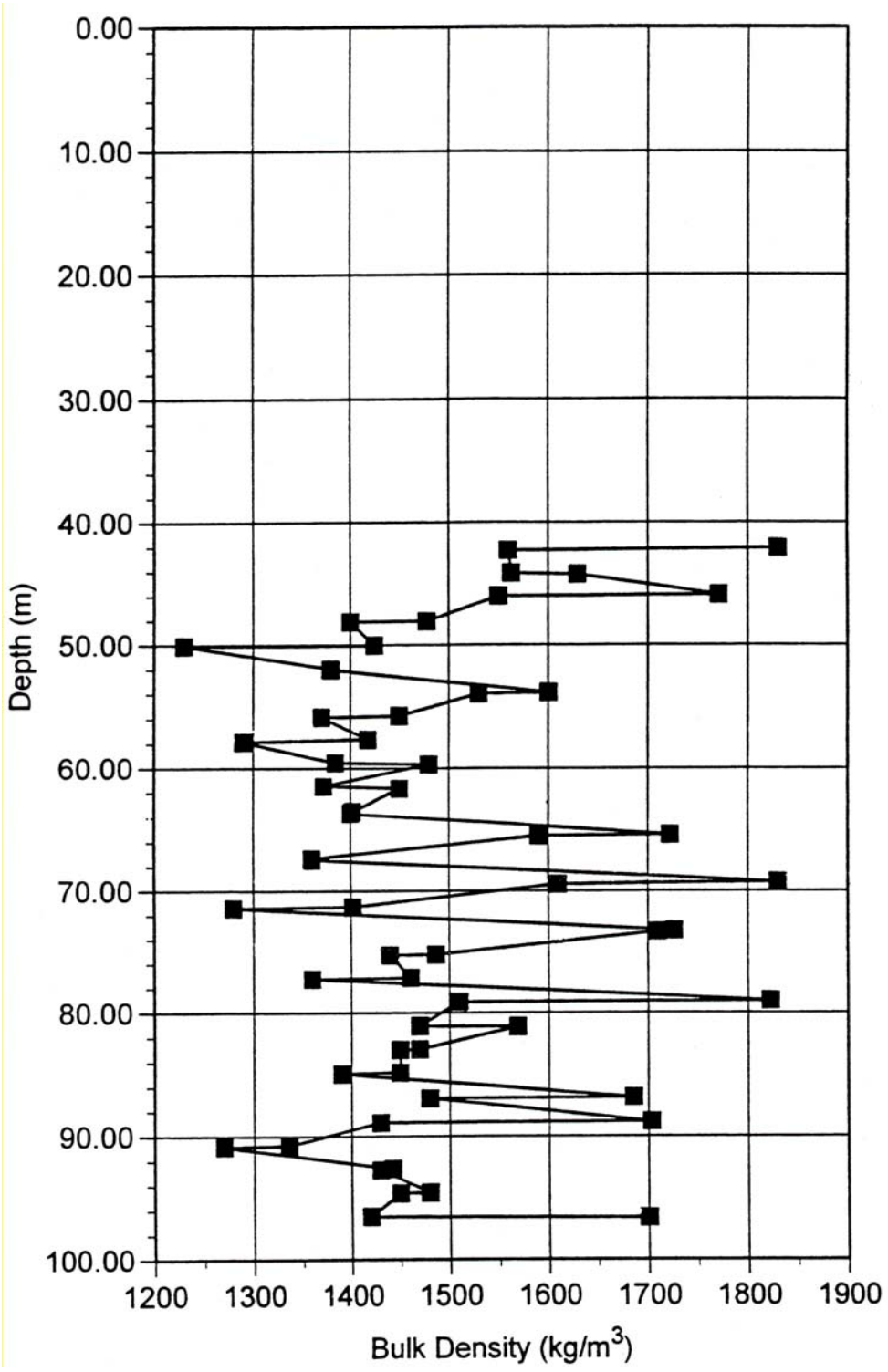


Figure C-3
Dry Bulk Density versus Depth for U-3bl-D2
(In kilograms per cubic meter)

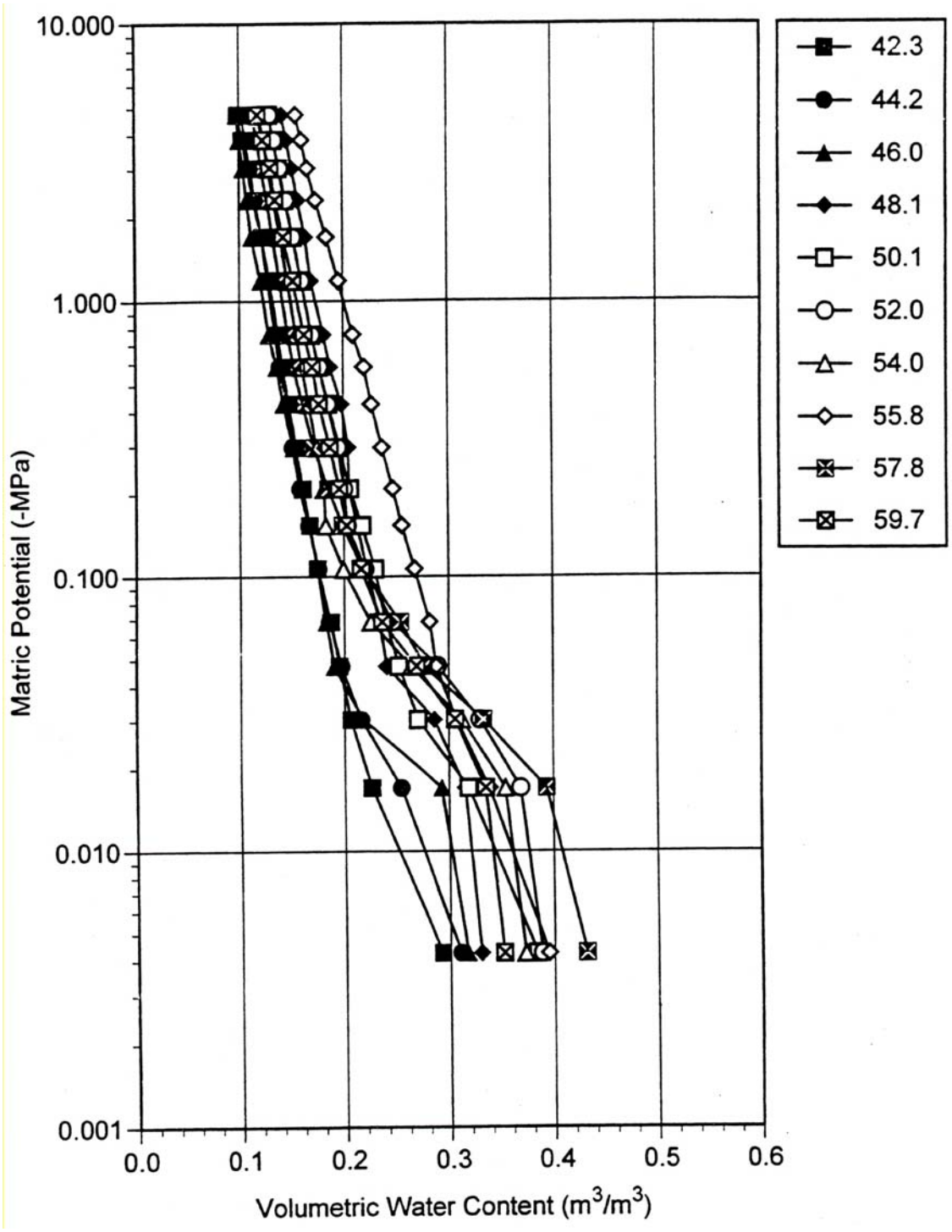


Figure C-4
Water Retention Relations for U-3bl-D2 Samples at 10 Depths from 42.3 to 59.7 Meters
(Depths indicated by symbols; matric potential in negative MegaPascals [-MPa]; water content in cubic meters per cubic meter)

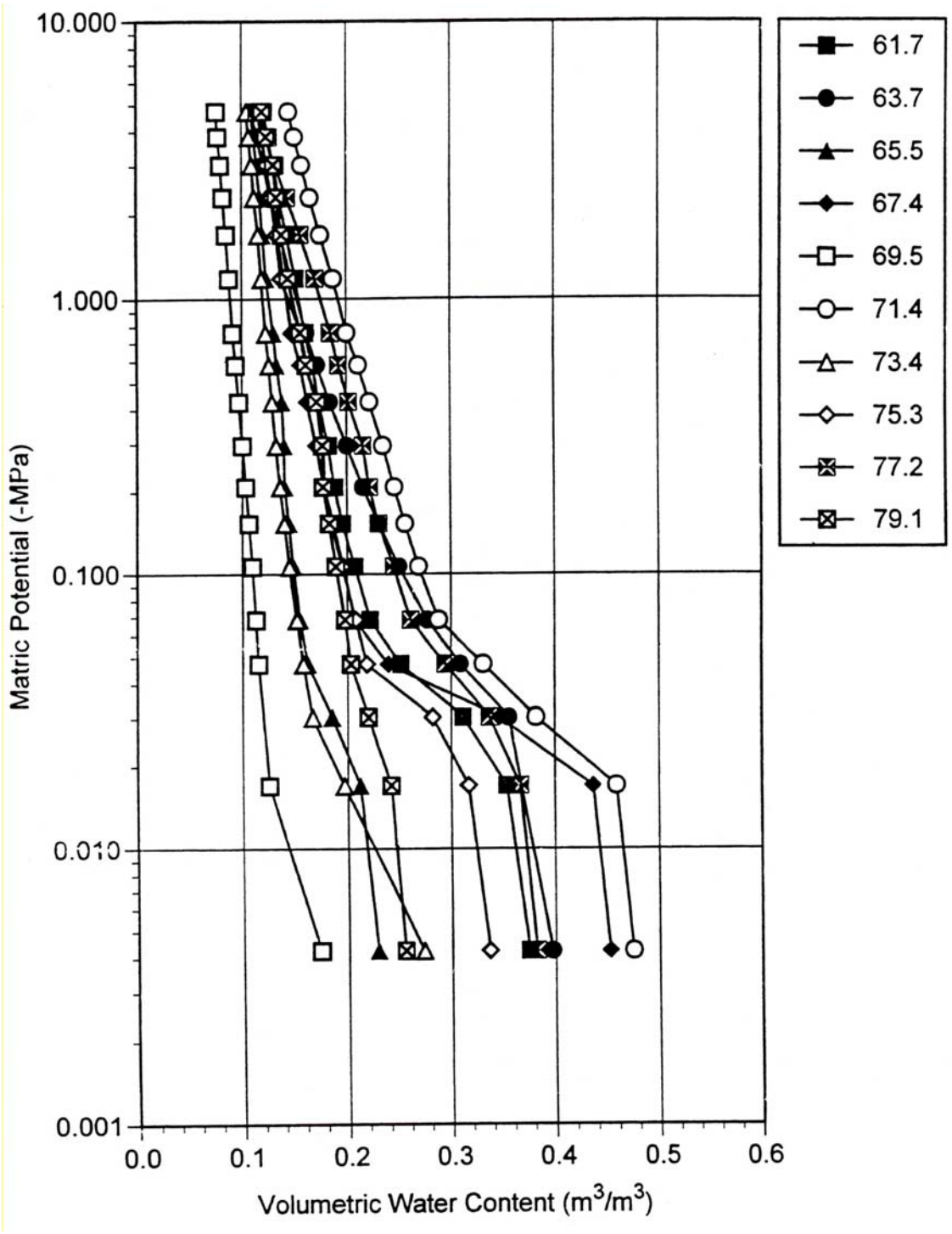


Figure C-5
Water Retention Relations for U-3bl-D2 Samples at 10 Depths from 61.7 to 79.1 Meters
(Depths indicated by symbols; matric potential in negative MegaPascals [-MPa]; water content in cubic meters per cubic meter)

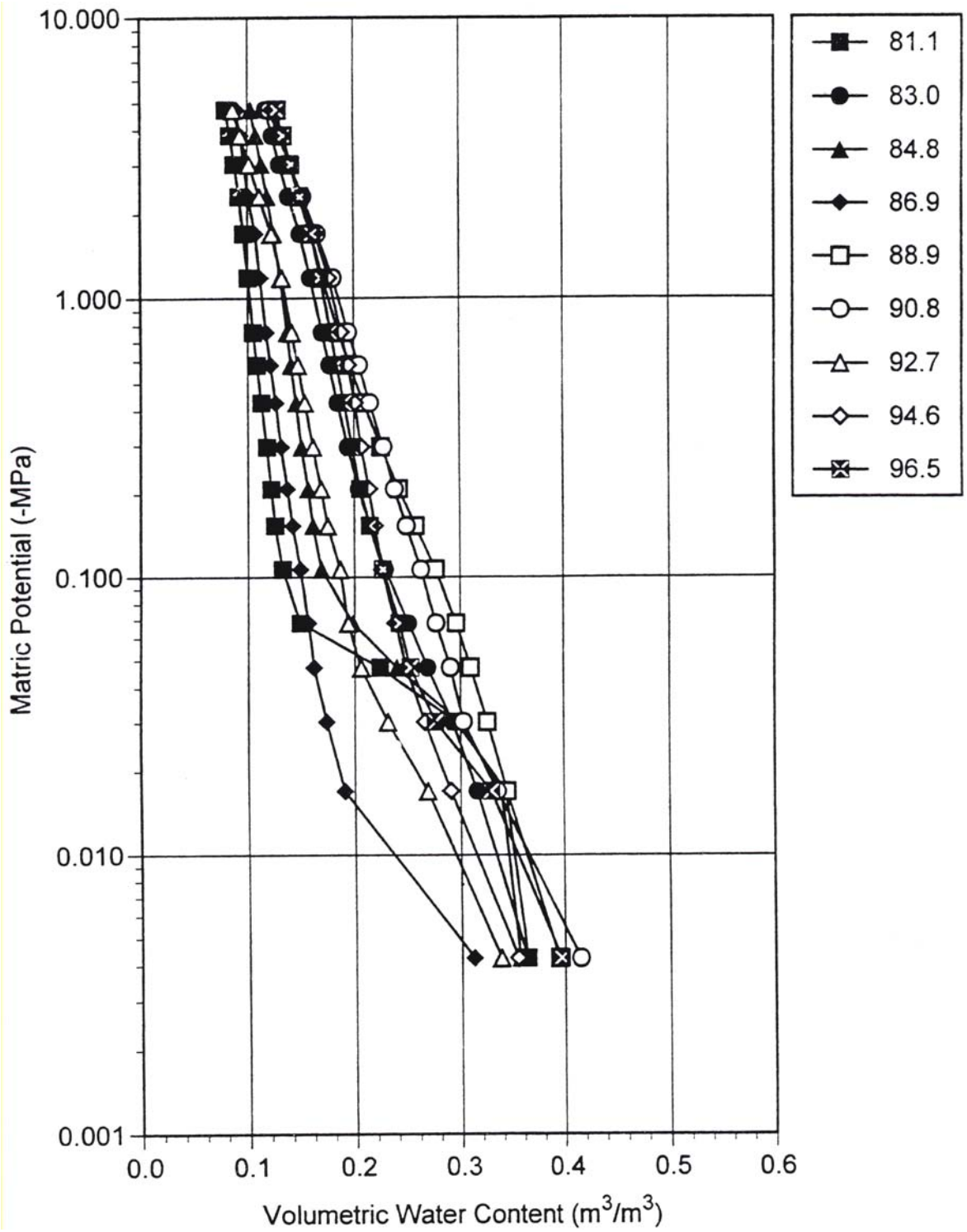


Figure C-6
Water Retention Relations for U-3bl-D2 Samples at 9 Depths from 81.1 to 96.5 Meters
(Depths indicated by symbols; matric potential in negative MegaPascals [-MPa]; water content in cubic meters per cubic meter)

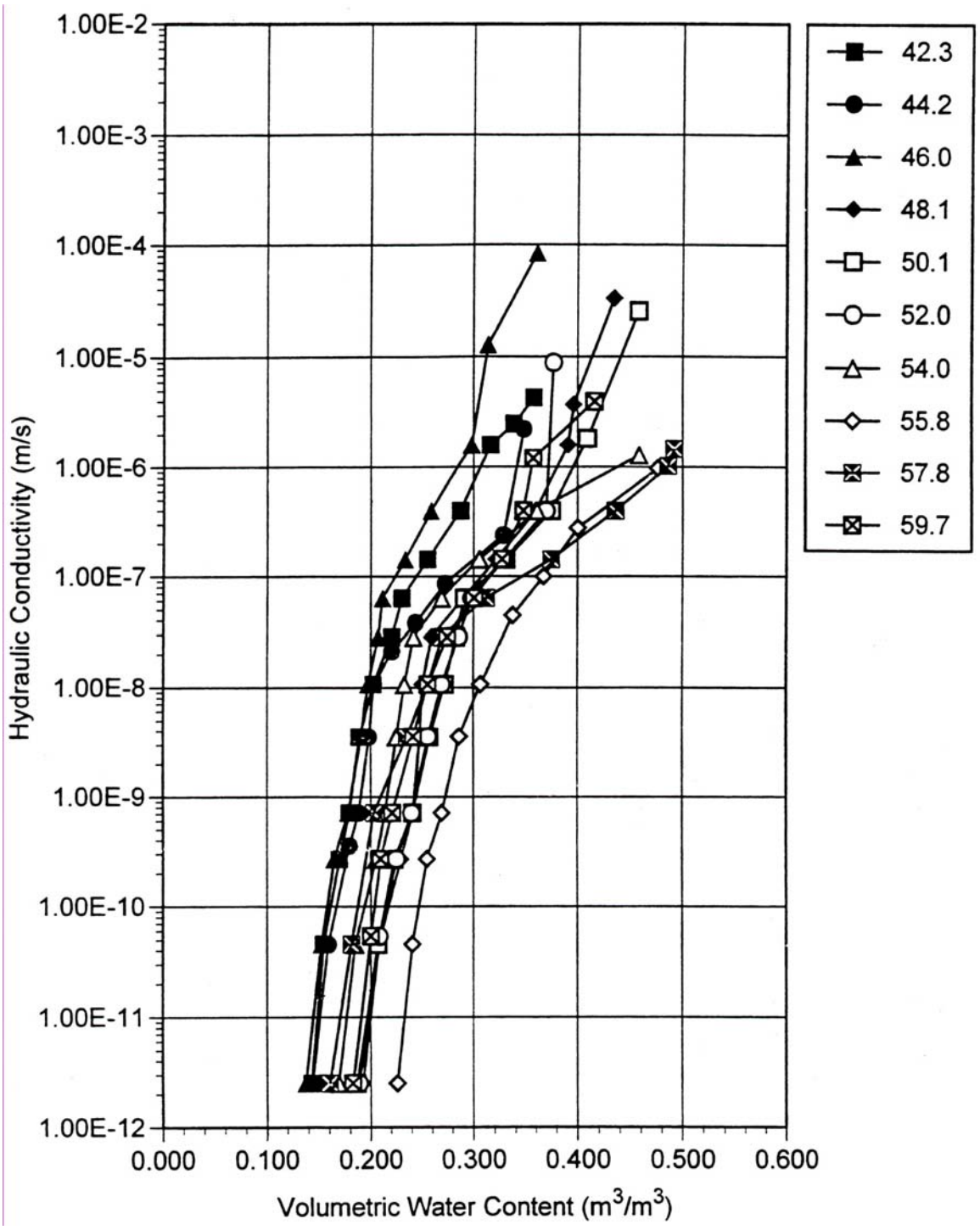


Figure C-7
Hydraulic Conductivity versus Volumetric Water Content for U-3bl-D2 Samples at 10 Depths from 42.3 to 59.7 Meters
(Depths as indicated by symbols; hydraulic conductivity in meters per second; water content in cubic meters per cubic meter)

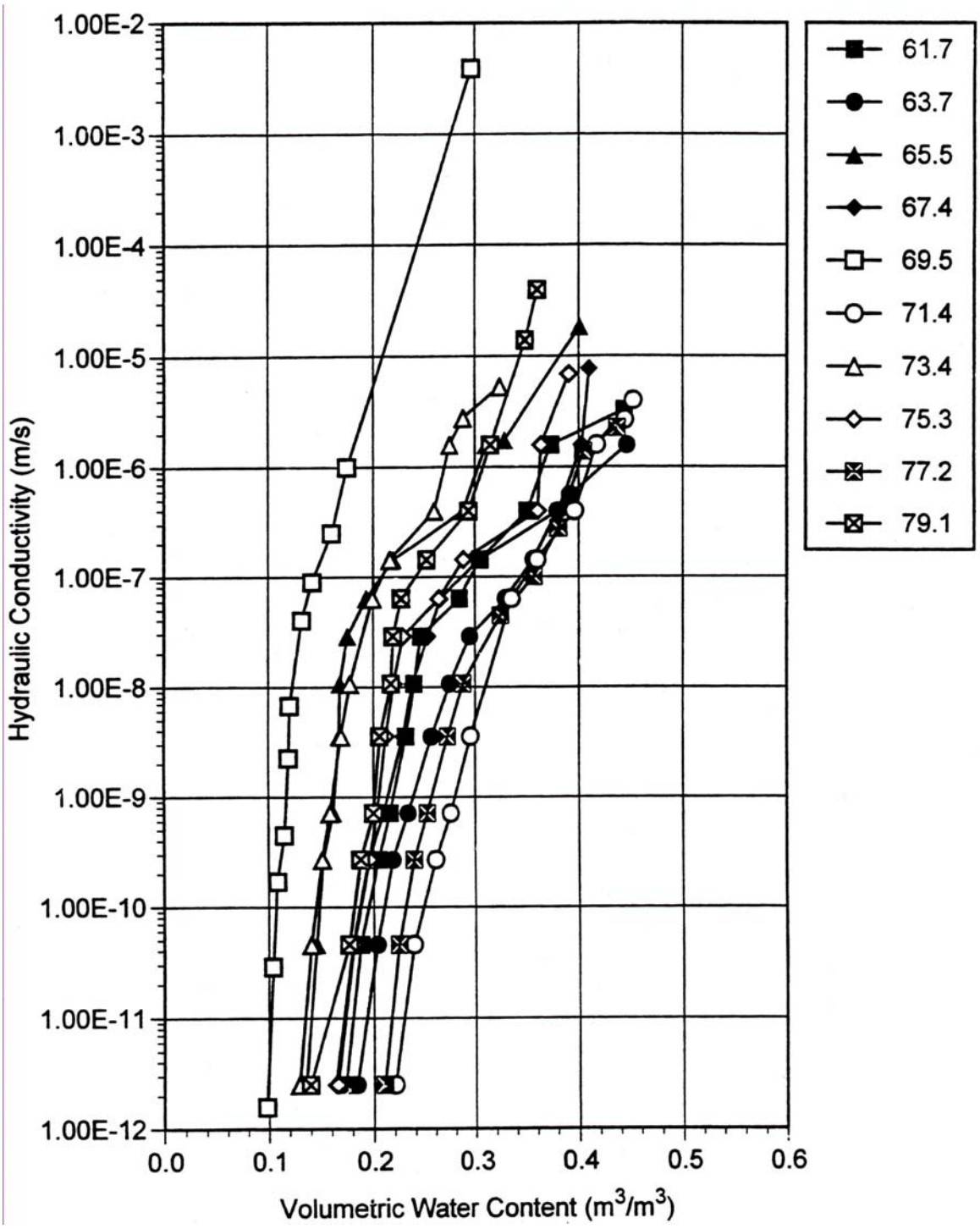


Figure C-8
Hydraulic Conductivity versus Volumetric Water Content for U-3bl-D2 Samples at 10 Depths from 61.7 to 79.1 Meters
(Depths as indicated by symbols; hydraulic conductivity in meters per second; water content in cubic meters per cubic meter)

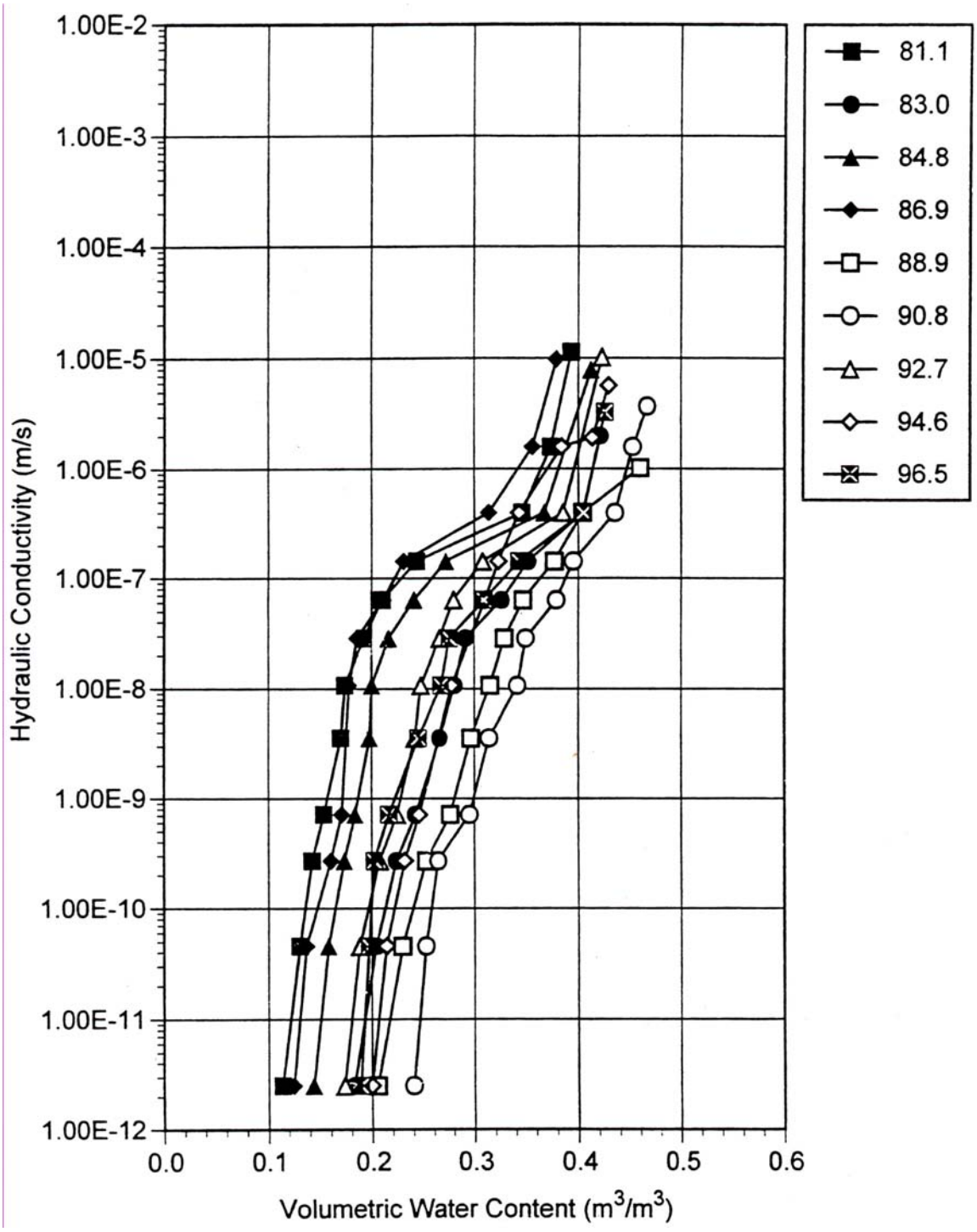


Figure C-9
Hydraulic Conductivity versus Volumetric Water Content for U-3bl-D2 Samples at 9 Depths from 81.1 to 96.5 Meters
(Depths as indicated by symbols; hydraulic conductivity in meters per second; water content in cubic meters per cubic meter)

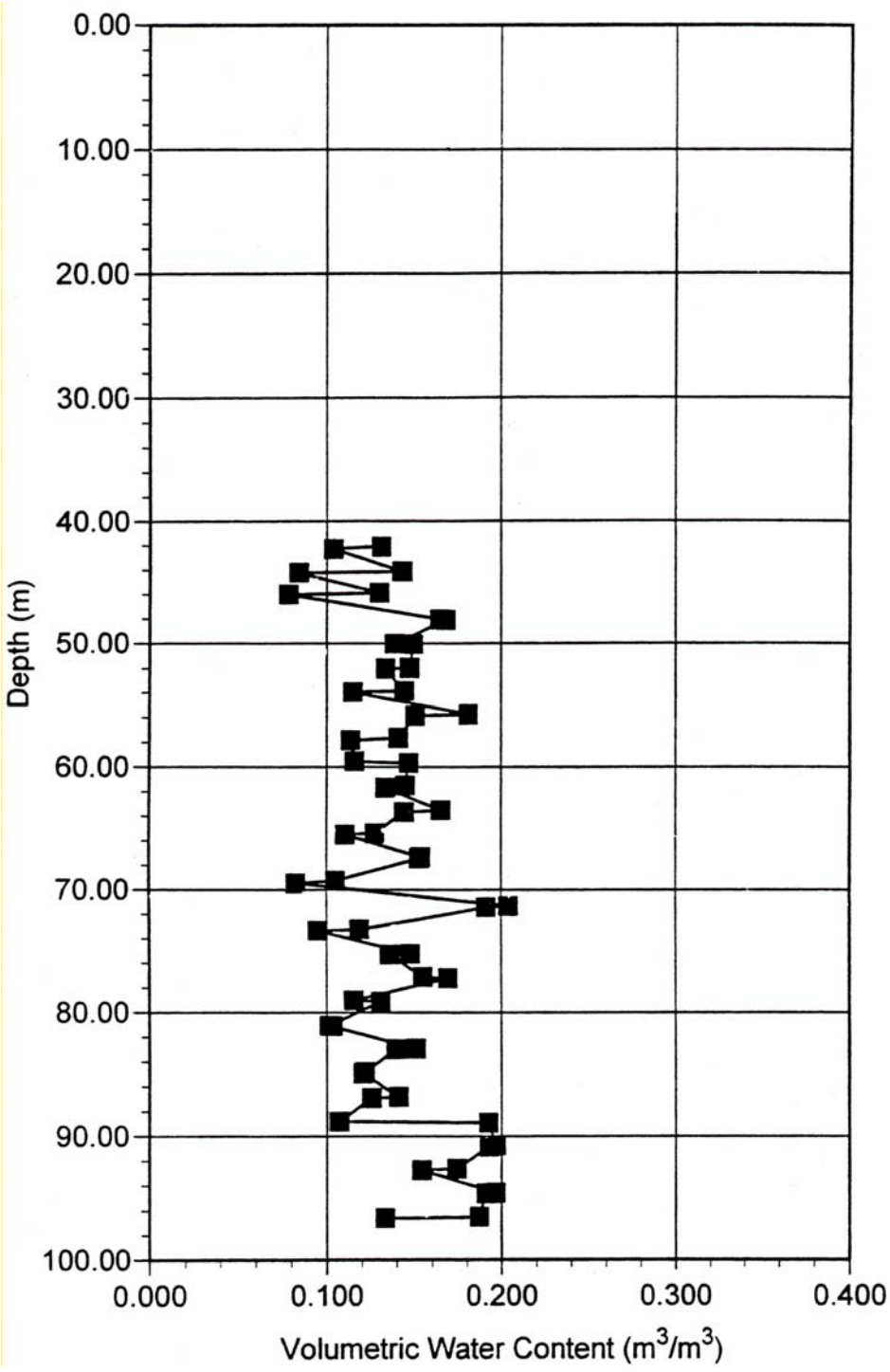


Figure C-10
Volumetric Water Content versus Depth for U-3bl-D2
(Water content in cubic meters per cubic meter)

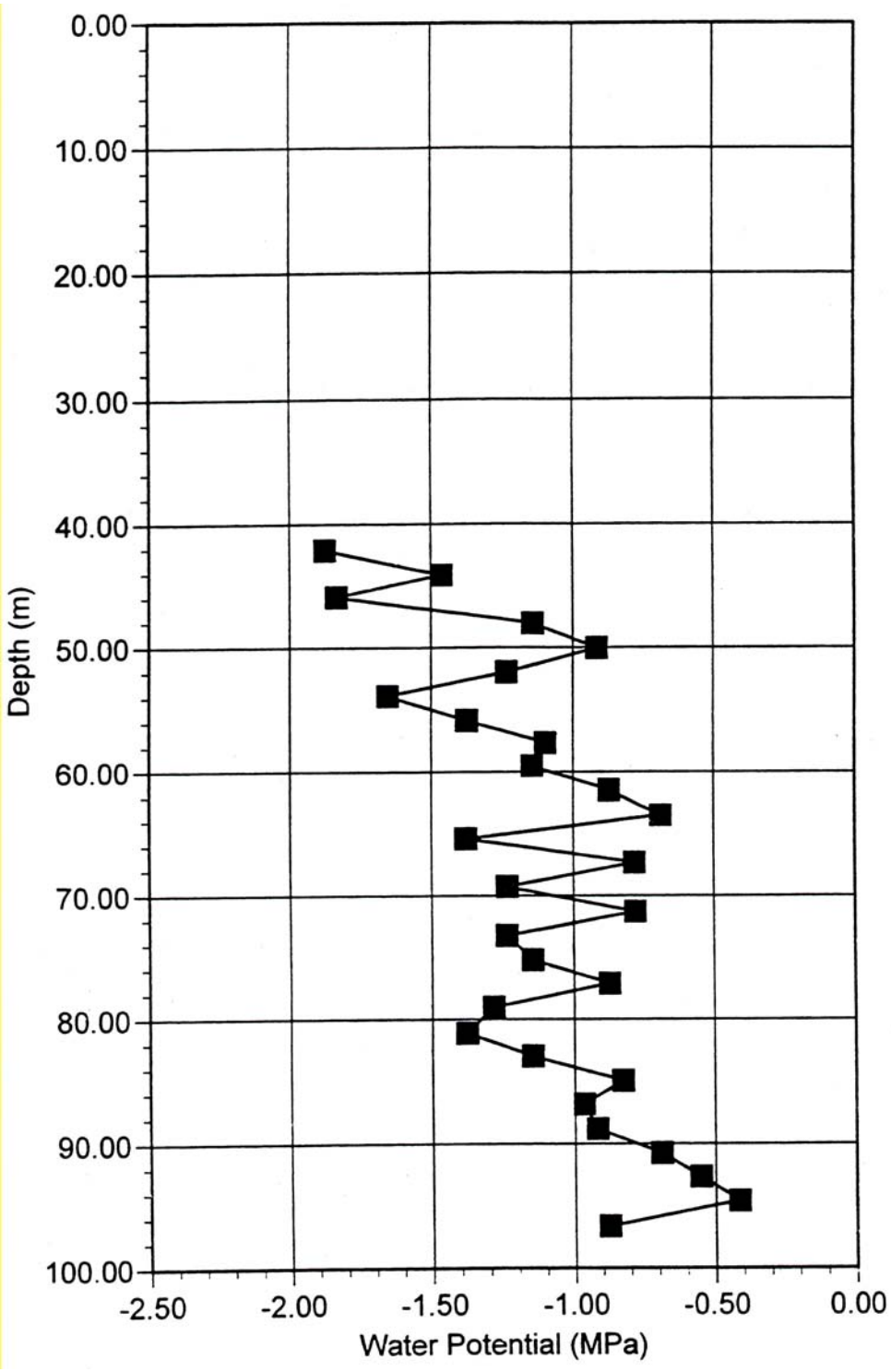


Figure C-11
Water Potential versus Depth for U-3bl-D2
(Water in MegaPascals)

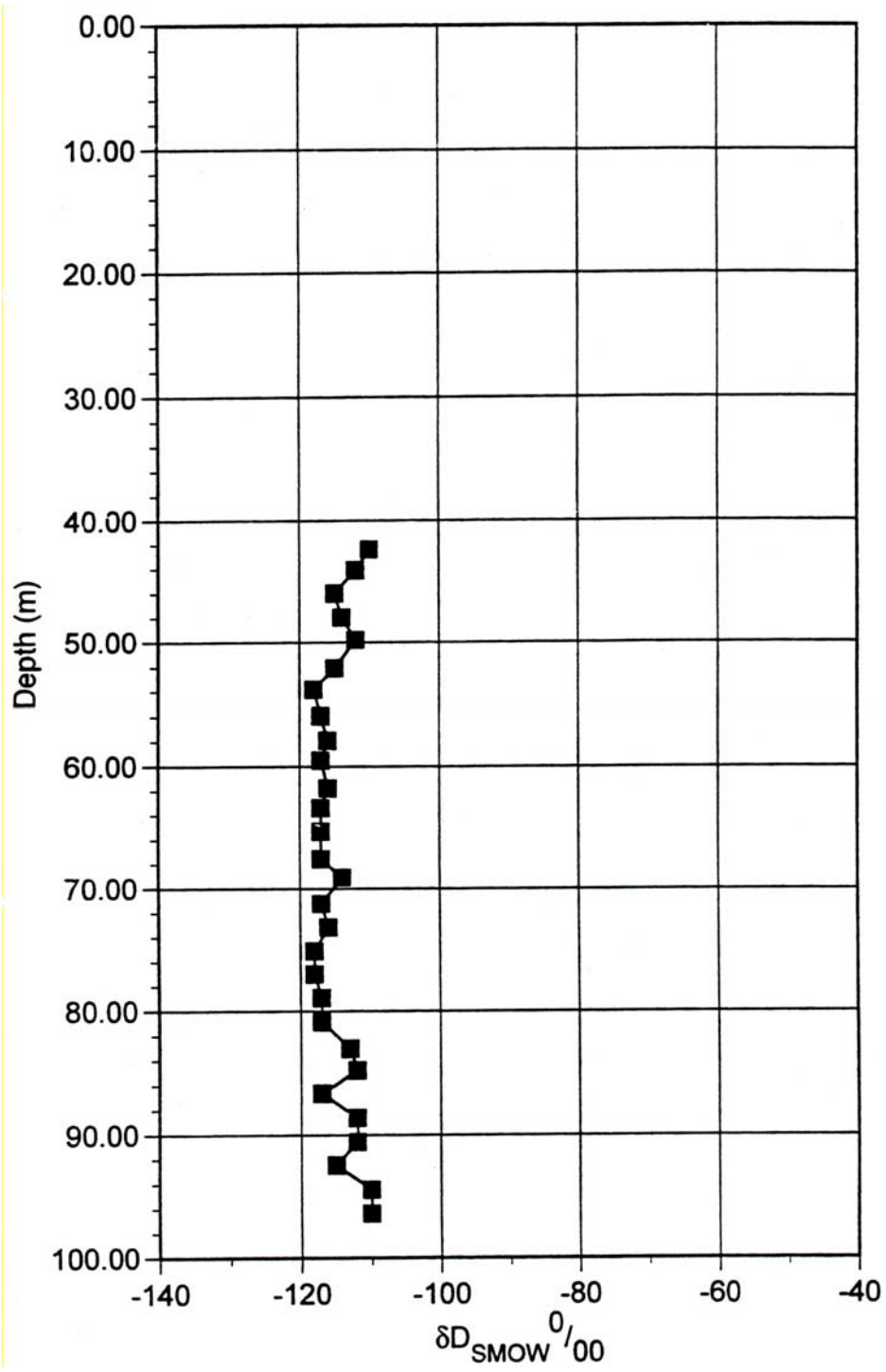


Figure C-12
Stable Hydrogen Isotope Concentration in Pore Water from U-3bl-D2 versus Depth
(Expressed in standard delta notation relative to standard mean ocean water in parts per thousand)

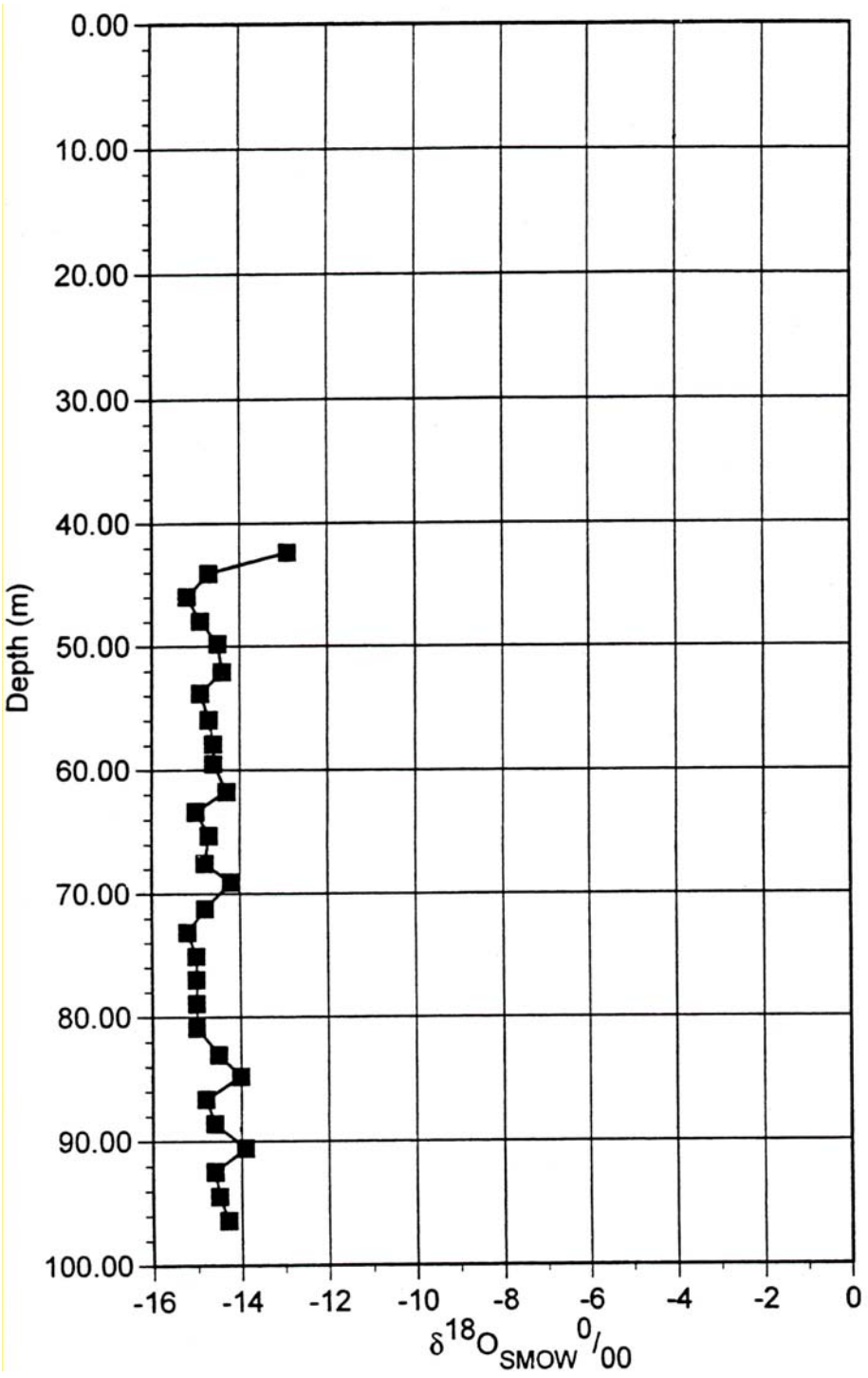


Figure C-13
Stable Oxygen Isotope Concentration in Pore Water from U-3bl-D2 versus Depth
(Expressed in standard delta notation relative to standard mean ocean water in parts per thousand)

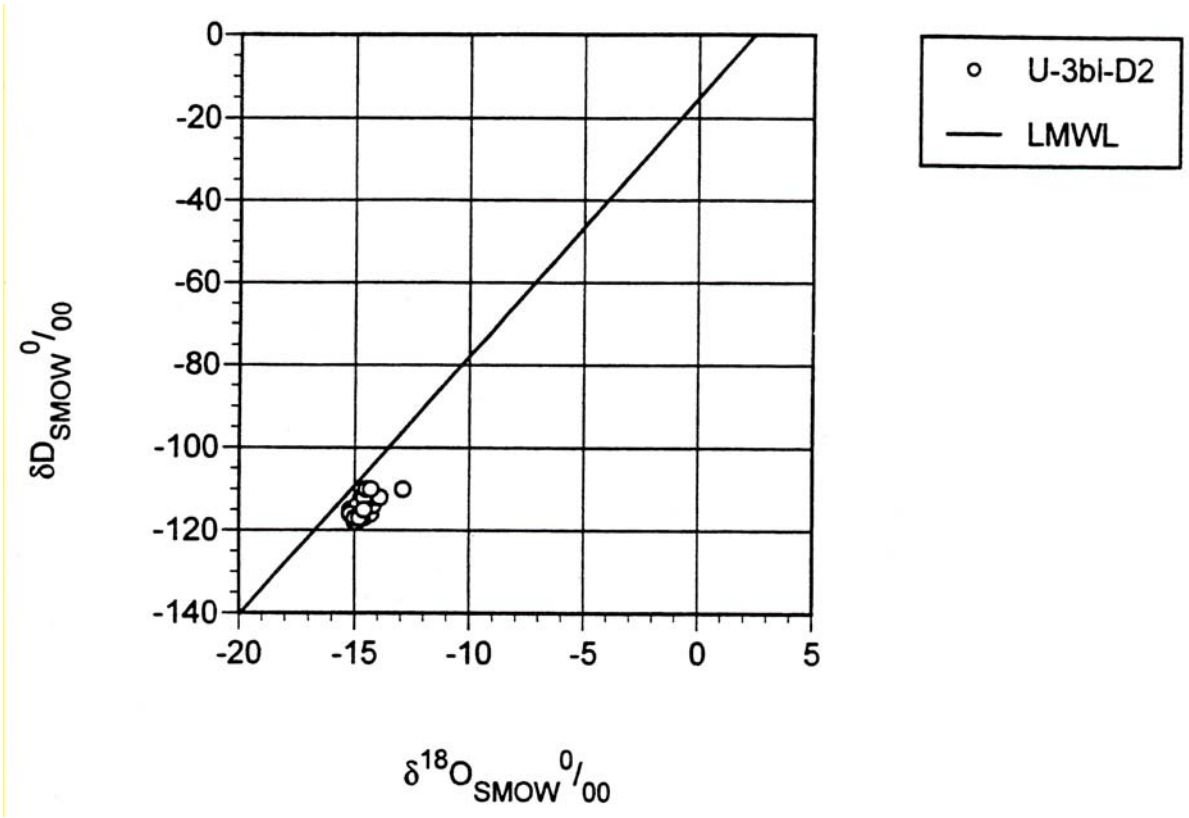


Figure C-14
Stable Isotope Concentration in Pore Water from U-3bl-D2 Alluvium Samples with respect to Local Meteoric Water Line
(Expressed in standard delta notation relative to standard mean ocean water in parts per thousand)

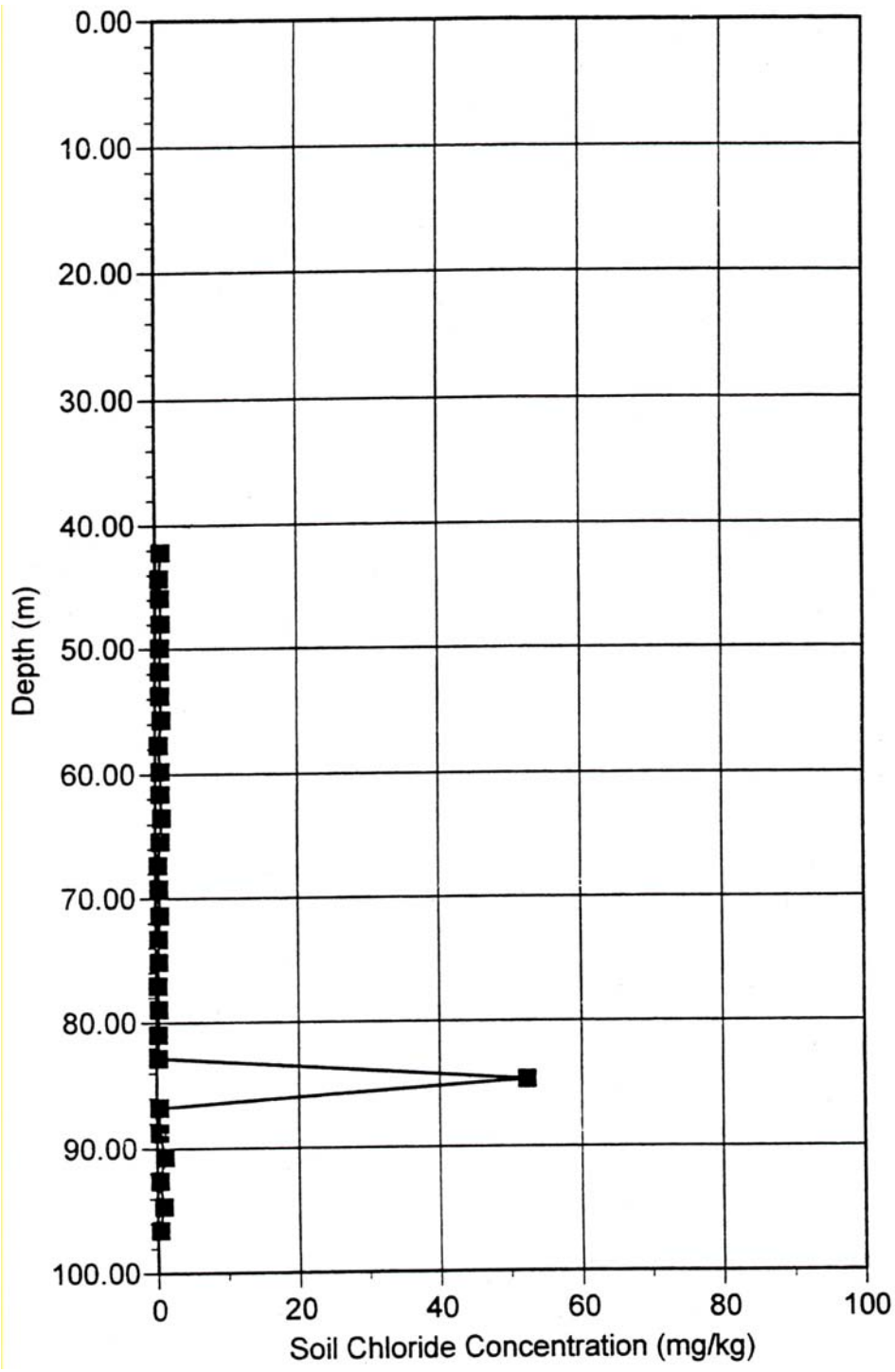


Figure C-15
Soil Chloride Concentration versus Depth for U-3bl-D2
(In milligrams per kilogram)

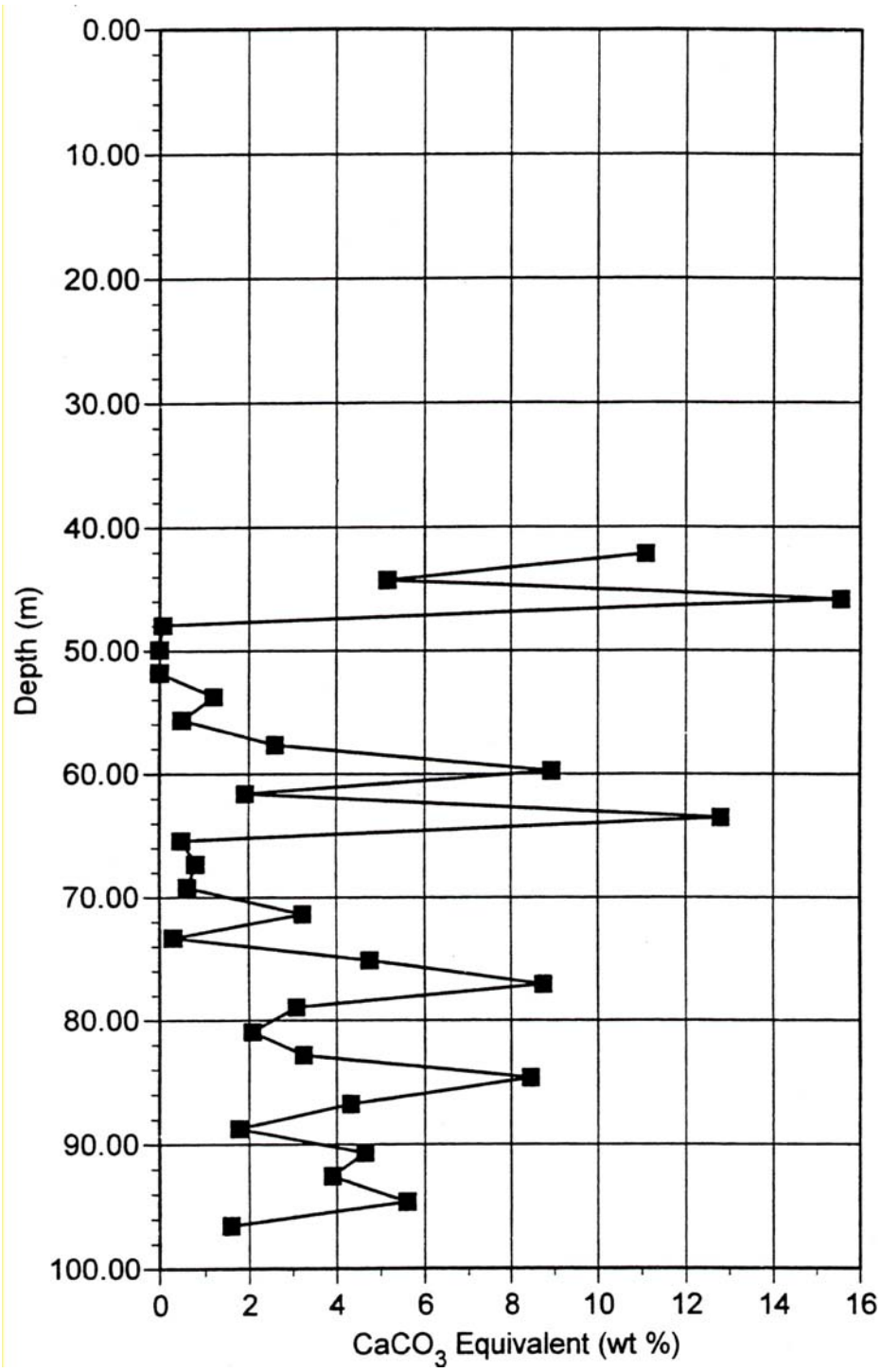


Figure C-16
Calcium Carbonate Equivalent within the Fine-Earth Fraction (less than 2 millimeters) versus Depth for U-3bl-D2
(Oven-dry weight percent)

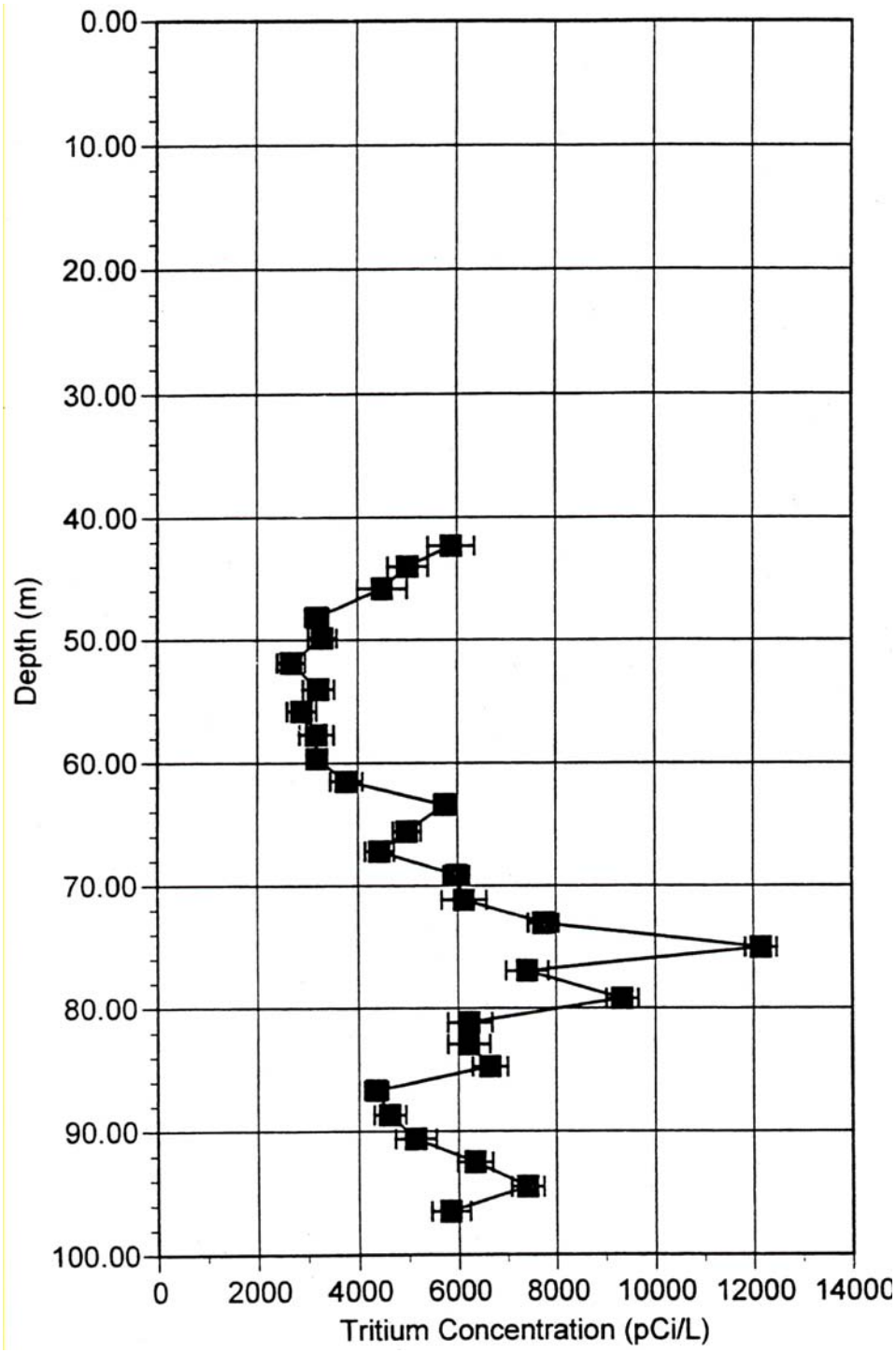


Figure C-17
Tritium Concentration versus Depth for U-3bl-D2
(In picoCuries per liter; bars indicate counting error)

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ATTACHMENT D

CHARACTERIZATION DATA TABLES FOR

BOREHOLE U-3bl-D2

Table D-1. Particle density for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Particle Density
Depth (m)	Density (kg/m^3)
42.17	2350
44.30	2430
45.88	2430
47.96	2330
49.92	2410
51.79	2310
53.75	2390
55.69	2460
57.68	2250
59.76	2360
61.60	2270
63.52	2330
65.41	2420
67.32	2310
69.21	2400
71.37	2210
73.31	2380
75.15	2300
77.06	2340
78.93	2410
80.94	2410
82.83	2270
84.67	2300
86.75	2440
88.74	2440
90.68	2290
92.57	2280
94.63	2390
96.54	2380

Table D-2. Particle size distribution for the fine-earth (< 2 mm) fraction for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Particle Size									
	Sand (0.05 - 2 mm) (wt %)						Silt (2 - 50 mm) (wt %)			Clay (< 2 mm) (wt %)
Depth (m)	1 - 2 mm	0.5 - 1 mm	0.25 - 0.5 mm	0.1 - 0.25 mm	0.05 - 0.1 mm	Total Sand	20 -50 mm	2 - 20 mm	Total Silt	Total Clay
42.17	15.1	15.9	22.6	25.9	9.1	88.6	0.5	4.8	5.3	6.1
44.30	7.8	8.9	17.8	30.1	17.2	81.8	4.9	6.4	11.3	6.9
45.88	9.4	11.8	13.9	17.9	17.3	70.4	8.3	14.6	22.9	6.7
47.96	10.3	15.4	26.6	21.9	8.0	82.2	0.6	4.4	5.0	12.8
49.92	22.3	21.6	25.0	18.5	3.5	90.9	0.0	2.3	2.3	6.8
51.79	6.8	9.8	18.4	24.0	10.7	69.7	3.1	14.2	17.3	13.0
53.75	6.5	8.1	16.1	30.9	18.8	80.4	3.1	7.4	10.5	9.1
55.69	7.1	7.4	16.6	27.0	12.2	70.4	2.4	13.1	15.5	14.1
57.68	1.0	2.3	9.5	29.8	31.2	73.8	12.5	10.1	22.6	3.6
59.76	5.1	6.3	15.3	30.9	14.8	72.3	1.3	14.9	16.2	11.5
61.60	6.9	9.6	19.8	29.9	13.8	80.1	2.7	7.4	10.1	9.8
63.52	3.4	3.4	9.3	25.1	19.6	60.8	6.6	22.4	29.0	10.2
65.41	29.2	32.4	18.2	4.7	1.7	86.2	0.0	1.9	1.9	11.9
67.32	7.7	11.0	21.2	28.5	12.2	80.5	3.3	6.9	10.2	9.3
69.21	29.9	18.1	20.6	16.0	6.0	90.6	1.6	3.5	5.1	4.3
71.37	10.2	13.5	18.7	21.8	9.5	73.8	2.0	7.3	9.3	16.9
73.31	18.6	20.4	21.8	11.2	5.4	77.4	2.3	4.1	6.4	16.2
75.15	5.7	8.7	15.8	27.3	17.7	75.2	4.6	9.6	14.2	10.6
77.06	3.9	5.8	14.9	33.4	21.0	79.1	5.0	8.3	13.3	7.6
78.93	13.4	13.9	23.2	30.9	8.1	89.4	1.0	2.8	3.8	6.8
80.94	26.7	25.7	28.1	11.4	2.6	94.5	1.4	1.5	2.9	2.6
82.83	5.8	7.1	16.7	35.1	18.6	83.3	5.3	5.7	11.0	5.7
84.67	4.2	8.2	16.2	29.2	15.6	73.5	3.9	8.3	12.2	14.3
86.75	31.4	24.0	19.5	12.7	4.1	91.5	1.8	2.9	4.7	3.8
88.74	20.7	24.9	24.6	13.3	2.7	86.3	0.8	4.6	5.4	8.3
90.68	14.1	6.8	10.1	25.5	22.8	79.3	4.1	7.0	11.1	9.6
92.57	10.7	11.5	17.5	25.6	15.9	81.1	4.3	7.0	11.3	7.6
94.63	7.1	9.1	18.6	30.8	15.7	81.2	3.6	5.6	9.2	9.6
96.54	12.5	14.3	25.9	28.2	6.4	87.2	1.5	2.9	4.4	8.4

Table D-3. Bulk density for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Dry Bulk Density		
Depth (m)	Bulk Density (kg/m^3)	Depth (m)	Bulk Density (kg/m^3)
42.10	1830	69.48	1610
42.29	1560	71.32	1402
44.13	1563	71.42	1280
44.23	1630	73.26	1726
45.90	1772	73.35	1710
46.02	1550	75.24	1486
48.06	1478	75.29	1440
48.10	1400	77.13	1461
50.04	1425	77.23	1360
50.09	1230	79.02	1822
51.98	1379	79.12	1510
52.03	1380	81.06	1470
53.87	1600	81.11	1569
53.97	1530	82.95	1470
55.76	1450	83.00	1450
55.86	1370	84.84	1450
57.65	1418	84.94	1390
57.85	1290	86.83	1686
59.54	1384	86.92	1480
59.69	1480	88.81	1703
61.48	1372	88.91	1430
61.67	1450	90.75	1336
63.52	1402	90.85	1270
63.66	1400	92.64	1442
65.41	1722	92.74	1430
65.50	1590	94.58	1480
67.34	1359	94.63	1450
67.44	1360	96.52	1420
69.28	1830	96.62	1700

Table D-4. Water retention relations for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	42.3		44.2		46.0	
	θ (m^3 m^{-3})	h (MPa)	θ (m^3 m^{-3})	h(MPa)	θ (m^3 m^{-3})	h(MPa)
	0.293	0.004	0.310	0.004	0.317	0.004
	0.226	0.017	0.254	0.017	0.293	0.017
	0.206	0.030	0.216	0.030	0.218	0.030
	0.195	0.047	0.198	0.047	0.190	0.047
	0.187	0.068	0.186	0.068	0.183	0.068
	0.175	0.106	0.176	0.106	0.175	0.106
	0.167	0.153	0.166	0.153	0.167	0.153
	0.161	0.208	0.158	0.208	0.160	0.208
	0.154	0.295	0.151	0.295	0.151	0.295
	0.148	0.425	0.147	0.425	0.142	0.425
	0.142	0.579	0.139	0.579	0.136	0.579
	0.137	0.756	0.134	0.756	0.128	0.756
	0.129	1.182	0.128	1.182	0.121	1.182
	0.122	1.702	0.122	1.702	0.112	1.702
	0.114	2.316	0.116	2.316	0.107	2.316
	0.108	3.025	0.111	3.025	0.104	3.025
	0.103	3.829	0.107	3.829	0.100	3.829
	0.099	4.727	0.103	4.727	0.098	4.727

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	48.1		50.1		52.0	
	θ (m^3 m^{-3})	h(MPa)	θ (m^3 m^{-3})	h(MPa)	θ (m^3 m^{-3})	h(MPa)
	0.330	0.004	0.384	0.004	0.388	0.004
	0.315	0.017	0.319	0.017	0.369	0.017
	0.286	0.030	0.270	0.030	0.330	0.030
	0.240	0.047	0.252	0.047	0.290	0.047
	0.233	0.068	0.239	0.068	0.246	0.068
	0.222	0.106	0.229	0.106	0.220	0.106
	0.213	0.153	0.217	0.153	0.203	0.153
	0.206	0.208	0.206	0.208	0.201	0.208
	0.205	0.295	0.196	0.295	0.195	0.295
	0.198	0.425	0.186	0.425	0.185	0.425
	0.187	0.579	0.177	0.579	0.177	0.579
	0.181	0.756	0.170	0.756	0.170	0.756
	0.169	1.182	0.160	1.182	0.160	1.182
	0.164	1.702	0.152	1.702	0.152	1.702
	0.157	2.316	0.144	2.316	0.145	2.316
	0.151	3.025	0.138	3.025	0.139	3.025
	0.146	3.829	0.133	3.829	0.134	3.829
	0.141	4.727	0.129	4.727	0.129	4.727

Table D-4. Water retention relations for U-3bl-D2 characterization samples (continued)

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	54.0		55.8		57.8	
	θ (m^3 m^{-3})	h (MPa)	θ (m^3 m^{-3})	h(MPa)	θ (m^3 m^{-3})	h(MPa)
	0.373	0.004	0.395	0.004	0.431	0.004
	0.354	0.017	0.339	0.017	0.394	0.017
	0.312	0.030	0.307	0.030	0.333	0.030
	0.263	0.047	0.288	0.047	0.276	0.047
	0.225	0.068	0.282	0.068	0.253	0.068
	0.199	0.106	0.267	0.106	0.219	0.106
	0.182	0.153	0.255	0.153	0.199	0.153
	0.181	0.208	0.247	0.208	0.185	0.208
	0.175	0.295	0.236	0.295	0.172	0.295
	0.167	0.425	0.227	0.425	0.161	0.425
	0.160	0.579	0.220	0.579	0.152	0.579
	0.154	0.756	0.209	0.756	0.147	0.756
	0.147	1.182	0.196	1.182	0.139	1.182
	0.140	1.702	0.184	1.702	0.132	1.702
	0.133	2.316	0.174	2.316	0.127	2.316
	0.128	3.025	0.166	3.025	0.122	3.025
	0.124	3.829	0.161	3.829	0.118	3.829
	0.120	4.727	0.155	4.727	0.113	4.727

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	59.7		61.7		63.7	
	θ (m^3 m^{-3})	h(MPa)	θ (m^3 m^{-3})	h(MPa)	θ (m^3 m^{-3})	h(MPa)
	0.352	0.004	0.375	0.004	0.397	0.004
	0.335	0.017	0.354	0.017	0.356	0.030
	0.306	0.030	0.312	0.030	0.309	0.047
	0.269	0.047	0.252	0.047	0.277	0.068
	0.236	0.068	0.222	0.068	0.250	0.106
	0.216	0.106	0.208	0.106	0.231	0.153
	0.203	0.153	0.196	0.153	0.215	0.208
	0.196	0.208	0.188	0.208	0.200	0.295
	0.187	0.295	0.182	0.295	0.184	0.425
	0.177	0.425	0.174	0.425	0.172	0.579
	0.170	0.579	0.168	0.579	0.162	0.756
	0.163	0.756	0.161	0.756	0.148	1.182
	0.152	1.182	0.152	1.182	0.138	1.702
	0.143	1.702	0.144	1.702	0.129	2.316
	0.135	2.316	0.136	2.316	0.121	3.025
	0.130	3.025	0.131	3.025	0.115	3.829
	0.123	3.829	0.126	3.829	0.110	4.727
	0.118	4.727	0.122	4.727		

Table D-4. Water retention relations for U-3bi-D2 characterization samples (continued)

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	65.5		67.4		69.5	
	θ ($m^3 m^{-3}$)	h (MPa)	θ ($m^3 m^{-3}$)	h(MPa)	θ ($m^3 m^{-3}$)	h(MPa)
	0.229	0.004	0.452	0.004	0.174	0.004
	0.212	0.017	0.436	0.017	0.126	0.017
	0.186	0.030	0.346	0.030	0.115	0.047
	0.163	0.047	0.239	0.047	0.113	0.068
	0.155	0.068	0.207	0.068	0.110	0.106
	0.149	0.106	0.196	0.106	0.106	0.153
	0.145	0.153	0.187	0.153	0.103	0.208
	0.141	0.208	0.179	0.208	0.100	0.295
	0.141	0.295	0.171	0.295	0.097	0.425
	0.139	0.425	0.163	0.425	0.094	0.579
	0.134	0.579	0.157	0.579	0.091	0.756
	0.131	0.756	0.148	0.756	0.088	1.182
	0.124	1.182	0.141	1.182	0.085	1.702
	0.120	1.702	0.135	1.702	0.082	2.316
	0.117	2.316	0.129	2.316	0.080	3.025
	0.115	3.025	0.124	3.025	0.078	3.829
	0.112	3.829	0.120	3.829	0.076	4.727
	0.110	4.727	0.116	4.727		

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	71.4		73.4		75.3	
	θ ($m^3 m^{-3}$)	h(MPa)	θ ($m^3 m^{-3}$)	h(MPa)	θ ($m^3 m^{-3}$)	h(MPa)
	0.475	0.004	0.273	0.004	0.337	0.004
	0.459	0.017	0.197	0.017	0.317	0.017
	0.382	0.030	0.167	0.030	0.282	0.030
	0.331	0.047	0.158	0.047	0.219	0.047
	0.288	0.068	0.152	0.068	0.208	0.068
	0.269	0.106	0.145	0.106	0.195	0.106
	0.256	0.153	0.141	0.153	0.186	0.153
	0.246	0.208	0.137	0.208	0.179	0.208
	0.235	0.295	0.133	0.295	0.178	0.295
	0.222	0.425	0.129	0.425	0.172	0.425
	0.211	0.579	0.126	0.579	0.163	0.579
	0.200	0.756	0.123	0.756	0.158	0.756
	0.187	1.182	0.119	1.182	0.138	1.182
	0.176	1.702	0.116	1.702	0.134	1.702
	0.166	2.316	0.112	2.316	0.129	2.316
	0.158	3.025	0.110	3.025	0.124	3.025
	0.151	3.829	0.107	3.829	0.120	3.829
	0.146	4.727	0.105	4.727	0.117	4.727

Table D-4. Water retention relations for U-3bl-D2 characterization samples (continued)

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	77.2		79.1		81.1	
	θ ($m^3 m^{-3}$)	h (MPa)	θ ($m^3 m^{-3}$)	h(MPa)	θ ($m^3 m^{-3}$)	h(MPa)
	0.383	0.004	0.255	0.004	0.364	0.004
	0.367	0.017	0.242	0.017	0.344	0.017
	0.337	0.030	0.220	0.030	0.295	0.030
	0.294	0.047	0.203	0.047	0.224	0.047
	0.261	0.068	0.198	0.068	0.148	0.068
	0.245	0.106	0.189	0.106	0.132	0.106
	0.231	0.153	0.183	0.153	0.125	0.153
	0.222	0.208	0.178	0.208	0.121	0.208
	0.215	0.295	0.177	0.295	0.117	0.295
	0.202	0.425	0.172	0.425	0.112	0.425
	0.193	0.579	0.162	0.579	0.108	0.579
	0.185	0.756	0.157	0.756	0.105	0.756
	0.171	1.182	0.145	1.182	0.100	1.182
	0.157	1.702	0.139	1.702	0.096	1.702
	0.144	2.316	0.134	2.316	0.092	2.316
	0.133	3.025	0.131	3.025	0.088	3.025
	0.124	3.829	0.124	3.829	0.084	3.829
	0.115	4.727	0.120	4.727	0.080	4.727

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	83.0		84.8		86.9	
	θ ($m^3 m^{-3}$)	h(MPa)	θ ($m^3 m^{-3}$)	h(MPa)	θ ($m^3 m^{-3}$)	h(MPa)
	0.363	0.004	0.357	0.004	0.312	0.004
	0.316	0.017	0.339	0.017	0.190	0.017
	0.292	0.030	0.299	0.030	0.173	0.030
	0.269	0.047	0.240	0.047	0.161	0.047
	0.251	0.068	0.199	0.068	0.156	0.068
	0.229	0.106	0.168	0.106	0.149	0.106
	0.215	0.153	0.161	0.153	0.141	0.153
	0.204	0.208	0.156	0.208	0.136	0.208
	0.194	0.295	0.150	0.295	0.131	0.295
	0.184	0.425	0.145	0.425	0.126	0.425
	0.176	0.579	0.140	0.579	0.121	0.579
	0.170	0.756	0.137	0.756	0.117	0.756
	0.158	1.182	0.130	1.182	0.112	1.182
	0.149	1.702	0.124	1.702	0.107	1.702
	0.138	2.316	0.118	2.316	0.101	2.316
	0.130	3.025	0.113	3.025	0.097	3.025
	0.123	3.829	0.108	3.829	0.093	3.829
	0.117	4.727	0.103	4.727	0.090	4.727

Table D-4. Water retention relations for U-3bl-D2 characterization samples (continued)

Location: U-3bl-D2	Analysis: Water Retention					
Depth (m)	88.9 θ (m^2 m^{-3})	h (MPa)	90.8 θ (m^3 m^{-3})	h(MPa)	92.7 θ (m^3 m^{-3})	h(MPa)
	0.395	0.004	0.415	0.004	0.338	0.004
	0.345	0.017	0.335	0.017	0.269	0.017
	0.326	0.030	0.303	0.030	0.231	0.030
	0.310	0.047	0.291	0.047	0.206	0.047
	0.296	0.068	0.277	0.068	0.194	0.068
	0.277	0.106	0.263	0.106	0.187	0.106
	0.258	0.153	0.249	0.153	0.175	0.153
	0.242	0.208	0.238	0.208	0.168	0.208
	0.226	0.295	0.228	0.295	0.161	0.295
	0.209	0.425	0.215	0.425	0.153	0.425
	0.196	0.579	0.205	0.579	0.147	0.579
	0.185	0.756	0.195	0.756	0.141	0.756
	0.170	1.182	0.180	1.182	0.132	1.182
	0.159	1.702	0.165	1.702	0.122	1.702
	0.148	2.316	0.152	2.316	0.111	2.316
	0.140	3.025	0.140	3.025	0.101	3.025
	0.133	3.829	0.129	3.829	0.093	3.829
	0.128	4.727	0.121	4.727	0.087	4.727

Location: U-3bl-D2	Analysis: Water Retention				
Depth (m)	94.6 θ (m^3 m^{-3})	h(MPa)	96.5 θ (m^3 m^{-3})	h(MPa)	
	0.354	0.004	0.397	0.004	
	0.291	0.017	0.329	0.017	
	0.266	0.030	0.276	0.030	
	0.249	0.047	0.253	0.047	
	0.239	0.068	0.242	0.068	
	0.226	0.106	0.227	0.106	
	0.219	0.153	0.215	0.153	
	0.214	0.208	0.206	0.208	
	0.207	0.295	0.198	0.295	
	0.201	0.425	0.191	0.425	
	0.195	0.579	0.184	0.579	
	0.188	0.756	0.178	0.756	
	0.176	1.182	0.163	1.182	
	0.163	1.702	0.160	1.702	
	0.150	2.316	0.149	2.316	
	0.139	3.025	0.141	3.025	
	0.130	3.829	0.133	3.829	
	0.123	4.727	0.127	4.727	

Table D-5. Hydraulic conductivity - water content relations for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	42.3		44.2		46.0	
	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)
	0.358	4.25E-06	0.348	2.22E-06	0.361	8.37E-05
	0.339	2.46E-06	0.328	2.38E-07	0.314	1.28E-05
	0.316	1.58E-06	0.273	8.55E-08	0.298	1.58E-06
	0.288	3.96E-07	0.244	3.80E-08	0.259	3.96E-07
	0.256	1.43E-07	0.221	2.14E-08	0.234	1.43E-07
	0.231	6.33E-08	0.203	1.07E-08	0.212	6.33E-08
	0.221	2.85E-08	0.198	3.56E-09	0.207	2.85E-08
	0.203	1.07E-08	0.188	7.13E-10	0.197	1.07E-08
	0.189	3.56E-09	0.180	3.56E-10	0.190	3.56E-09
	0.179	7.13E-10	0.159	4.56E-11	0.178	7.13E-10
	0.170	2.69E-10	0.144	2.50E-12	0.165	2.69E-10
	0.154	4.56E-11			0.153	4.56E-11
	0.143	2.50E-12			0.137	2.50E-12

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	48.1		50.1		52.0	
	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)
	0.434	3.29E-05	0.458	2.53E-05	0.377	8.86E-06
	0.396	3.70E-06	0.409	1.82E-06	0.370	3.96E-07
	0.391	1.58E-06	0.375	3.96E-07	0.329	1.43E-07
	0.360	3.96E-07	0.331	1.43E-07	0.299	6.33E-08
	0.321	1.43E-07	0.292	6.33E-08	0.286	2.85E-08
	0.291	6.33E-08	0.284	2.85E-08	0.270	1.07E-08
	0.260	2.85E-08	0.273	1.07E-08	0.256	3.56E-09
	0.250	1.07E-08	0.258	3.56E-09	0.240	7.13E-10
	0.248	3.56E-09	0.241	7.13E-10	0.225	2.69E-10
	0.241	7.13E-10	0.223	2.69E-10	0.209	5.39E-11
	0.229	2.69E-10	0.207	4.56E-11	0.189	2.50E-12
	0.208	4.56E-11	0.187	2.50E-12		
	0.192	2.50E-12				

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	54.0		55.8		57.8	
	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)
	0.458	1.27E-06	0.476	9.68E-07	0.492	1.46E-06
	0.361	3.96E-07	0.400	2.77E-07	0.486	1.01E-06
	0.305	1.43E-07	0.367	9.98E-08	0.436	3.96E-07
	0.270	6.33E-08	0.337	4.43E-08	0.375	1.43E-07
	0.242	2.85E-08	0.307	1.07E-08	0.312	6.33E-08
	0.233	1.07E-08	0.287	3.56E-09	0.270	2.85E-08
	0.225	3.56E-09	0.270	7.13E-10	0.256	1.07E-08
	0.214	7.13E-10	0.255	2.69E-10	0.235	3.56E-09
	0.205	2.69E-10	0.241	4.56E-11	0.203	7.13E-10
	0.185	4.56E-11	0.226	2.50E-12	0.181	4.56E-11
	0.169	2.50E-12			0.161	2.50E-12

Table D-5. Hydraulic conductivity - water content relations for U-3bl-D2 characterization samples (continued)

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	59.7		61.7		63.7	
	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)
	0.416	3.93E-06	0.444	3.28E-06	0.447	1.58E-06
	0.357	1.19E-06	0.374	1.58E-06	0.392	5.57E-07
	0.348	3.96E-07	0.351	3.96E-07	0.380	3.96E-07
	0.327	1.43E-07	0.305	1.43E-07	0.357	1.43E-07
	0.301	6.33E-08	0.285	6.33E-08	0.330	6.33E-08
	0.275	2.85E-08	0.246	2.85E-08	0.295	2.85E-08
	0.256	1.07E-08	0.239	1.07E-08	0.275	1.07E-08
	0.242	3.56E-09	0.231	3.56E-09	0.256	3.56E-09
	0.221	7.13E-10	0.216	7.13E-10	0.233	7.13E-10
	0.210	2.69E-10	0.205	2.69E-10	0.219	2.69E-10
	0.200	5.39E-11	0.188	4.56E-11	0.204	4.56E-11
	0.183	2.50E-12	0.174	2.50E-12	0.185	2.50E-12

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	65.5		67.4		69.5	
	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)
	0.401	1.83E-05	0.410	7.70E-06	0.297	3.92E-03
	0.329	1.74E-06	0.403	1.58E-06	0.175	1.00E-06
	0.311	1.58E-06	0.381	3.96E-07	0.161	2.50E-07
	0.289	3.96E-07	0.305	1.43E-07	0.142	9.00E-08
	0.219	1.43E-07	0.265	6.33E-08	0.132	4.00E-08
	0.194	6.33E-08	0.253	2.85E-08	0.120	6.75E-09
	0.176	2.85E-08	0.238	1.07E-08	0.119	2.25E-09
	0.168	1.07E-08	0.229	3.56E-09	0.116	4.50E-10
	0.168	3.56E-09	0.210	7.13E-10	0.109	1.70E-10
	0.162	7.13E-10	0.196	2.69E-10	0.104	2.88E-11
	0.153	2.69E-10	0.181	4.56E-11	0.098	1.58E-12
	0.146	4.56E-11	0.164	2.50E-12		
	0.136	2.50E-12				

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	71.4		73.4		75.3	
	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)
	0.445	2.67E-06	0.324	5.34E-06	0.391	6.90E-06
	0.453	4.00E-06	0.289	2.77E-06	0.364	1.58E-06
	0.417	1.58E-06	0.275	1.58E-06	0.361	3.96E-07
	0.396	3.96E-07	0.259	3.96E-07	0.289	1.43E-07
	0.361	1.43E-07	0.216	1.43E-07	0.264	6.33E-08
	0.336	6.33E-08	0.199	6.33E-08	0.228	2.85E-08
	0.295	3.56E-09	0.178	1.07E-08	0.220	1.07E-08
	0.276	7.13E-10	0.170	3.56E-09	0.212	3.56E-09
	0.261	2.69E-10	0.159	7.13E-10	0.203	7.13E-10
	0.239	4.56E-11	0.152	2.69E-10	0.196	2.69E-10
	0.221	2.50E-12	0.141	4.56E-11	0.182	4.56E-11
			0.129	2.50E-12	0.166	2.50E-12

Table D-5. Hydraulic conductivity - water content relations for U-3bl-D2 characterization samples (continued)

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	77.2		79.1		81.1	
	θ ($m^3 m^{-3}$)	K (m/s)	θ ($m^3 m^{-3}$)	K (m/s)	θ ($m^3 m^{-3}$)	K (m/s)
	0.437	2.26E-06	0.361	3.92E-05	0.394	1.12E-05
	0.405	1.38E-06	0.349	1.38E-05	0.374	1.58E-06
	0.381	2.77E-07	0.315	1.58E-06	0.346	3.96E-07
	0.358	9.98E-08	0.294	3.96E-07	0.243	1.43E-07
	0.325	4.43E-08	0.252	1.43E-07	0.210	6.33E-08
	0.288	1.07E-08	0.227	6.33E-08	0.193	2.85E-08
	0.272	3.56E-09	0.219	2.85E-08	0.174	1.07E-08
	0.252	7.13E-10	0.217	1.07E-08	0.170	3.56E-09
	0.239	2.69E-10	0.206	3.56E-09	0.154	7.13E-10
	0.224	4.56E-11	0.200	7.13E-10	0.142	2.69E-10
	0.210	2.50E-12	0.188	2.69E-10	0.131	4.56E-11
			0.177	4.56E-11	0.114	2.50E-12
			0.140	2.50E-12		

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	83.0		84.8		86.9	
	θ ($m^3 m^{-3}$)	K (m/s)	θ ($m^3 m^{-3}$)	K (m/s)	θ ($m^3 m^{-3}$)	K (m/s)
	0.421	1.99E-06	0.412	7.84E-06	0.379	9.76E-06
	0.404	3.96E-07	0.368	3.96E-07	0.357	1.58E-06
	0.352	1.43E-07	0.272	1.43E-07	0.314	3.96E-07
	0.326	6.33E-08	0.241	6.33E-08	0.231	1.43E-07
	0.292	2.85E-08	0.216	2.85E-08	0.211	6.33E-08
	0.281	1.07E-08	0.200	1.07E-08	0.186	2.85E-08
	0.266	3.56E-09	0.198	3.56E-09	0.178	1.07E-08
	0.242	7.13E-10	0.184	7.13E-10	0.171	7.13E-10
	0.224	2.69E-10	0.173	2.69E-10	0.160	2.69E-10
	0.205	4.56E-11	0.158	4.56E-11	0.137	4.56E-11
	0.183	2.50E-12	0.144	2.50E-12	0.125	2.50E-12

Location: U-3bl-D2	Analysis: Hydraulic Conductivity					
Depth (m)	88.9		90.8		92.7	
	θ ($m^3 m^{-3}$)	K (m/s)	θ ($m^3 m^{-3}$)	K (m/s)	θ ($m^3 m^{-3}$)	K (m/s)
	0.460	1.02E-06	0.467	3.69E-06	0.423	1.02E-05
	0.404	3.96E-07	0.452	1.58E-06	0.386	3.96E-07
	0.377	1.43E-07	0.435	3.96E-07	0.308	1.43E-07
	0.347	6.33E-08	0.395	1.43E-07	0.280	6.33E-08
	0.329	2.85E-08	0.379	6.33E-08	0.266	2.85E-08
	0.315	1.07E-08	0.350	2.85E-08	0.247	1.07E-08
	0.297	3.56E-09	0.342	1.07E-08	0.242	3.56E-09
	0.276	7.13E-10	0.314	3.56E-09	0.224	7.13E-10
	0.253	2.69E-10	0.295	7.13E-10	0.208	2.69E-10
	0.230	4.56E-11	0.264	2.69E-10	0.188	4.56E-11
	0.206	2.50E-12	0.252	4.56E-11	0.174	2.50E-12
			0.240	2.50E-12		

Table D-5. Hydraulic conductivity - water content relations for U-3bl-D2 characterization samples (continued)

Location: U-3bl-D2	Analysis: Hydraulic Conductivity				
Depth (m)	94.6		96.5		
	θ (m^3 m^{-3})	K (m/s)	θ (m^3 m^{-3})	K (m/s)	
	0.429	5.65E-06	0.426	3.26E-06	
	0.414	1.91E-06	0.405	3.96E-07	
	0.384	1.58E-06	0.343	1.43E-07	
	0.343	3.96E-07	0.310	6.33E-08	
	0.323	1.43E-07	0.276	2.85E-08	
	0.311	6.33E-08	0.267	1.07E-08	
	0.278	1.07E-08	0.245	3.56E-09	
	0.246	7.13E-10	0.217	7.13E-10	
	0.232	2.69E-10	0.203	2.69E-10	
	0.214	4.56E-11	0.197	4.56E-11	
	0.200	2.50E-12	0.189	2.50E-12	

Table D-6. Volumetric water content for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Volumetric Water Content		
Depth (m)	Water Content (m^3/m^3)	Depth (m)	Water Content (m^3/m^3)
42.10	0.131	73.26	0.119
42.29	0.104	73.35	0.095
44.13	0.143	75.24	0.148
44.23	0.084	75.29	0.136
45.90	0.130	77.13	0.155
46.02	0.079	77.23	0.169
48.06	0.165	79.02	0.115
48.10	0.168	79.12	0.131
50.04	0.139	81.06	0.102
50.09	0.149	81.11	0.103
51.98	0.147	82.95	0.151
52.03	0.134	83.00	0.140
53.87	0.144	84.84	0.122
53.97	0.115	84.94	0.121
55.76	0.181	86.83	0.141
55.86	0.151	86.92	0.126
57.65	0.141	88.81	0.107
57.85	0.114	88.91	0.193
59.54	0.116	90.75	0.197
59.69	0.147	90.85	0.193
61.48	0.145	92.64	0.174
61.67	0.134	92.74	0.154
63.52	0.165	94.58	0.197
63.66	0.144	94.63	0.191
65.41	0.128	96.52	0.187
65.50	0.111	96.62	0.133
67.34	0.154		
67.44	0.153		
69.28	0.105		
71.32	0.204		
71.42	0.191		

Table D-7. Water potential for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Water Potential
Depth (m)	Potential (MPa)
42.10	-1.873
44.13	-1.462
45.90	-1.832
48.06	-1.143
50.04	-0.914
51.98	-1.236
53.87	-1.652
55.86	-1.375
57.65	-1.099
59.54	-1.145
61.48	-0.871
63.52	-0.687
65.41	-1.379
67.34	-0.780
69.28	-1.236
71.32	-0.778
73.26	-1.238
75.24	-1.146
77.13	-0.871
79.02	-1.285
81.11	-1.378
82.95	-1.148
84.94	-0.826
86.83	-0.964
88.81	-0.918
90.75	-0.689
92.64	-0.552
94.58	-0.414
96.62	-0.875

Table D-8. Stable isotope concentrations for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Stable Isotopes	
Depth (m)	$\delta^{18}O$ (‰)	δD (‰)
42.39	-12.9	-110
44.08	-14.7	-112
45.97	-15.2	-115
47.96	-14.9	-114
49.80	-14.5	-112
52.08	-14.4	-115
53.82	-14.9	-118
55.96	-14.7	-117
57.89	-14.6	-116
59.49	-14.6	-117
61.77	-14.3	-116
63.37	-15.0	-117
65.31	-14.7	-117
67.54	-14.8	-117
69.09	-14.2	-114
71.22	-14.8	-117
73.16	-15.2	-116
75.10	-15.0	-118
76.99	-15.0	-118
78.93	-15.0	-117
80.87	-15.0	-117
83.05	-14.5	-113
84.79	-14.0	-112
86.63	-14.8	-117
88.62	-14.6	-112
90.56	-13.9	-112
92.45	-14.6	-115
94.44	-14.5	-110
96.37	-14.3	-110

Table D-9. Soil chloride concentrations for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Soil Chloride
Depth (m)	Chloride (mg/kg)
42.17	0.8
44.30	0.6
45.88	0.7
47.96	0.8
49.92	0.7
51.79	0.7
53.75	0.7
55.69	0.9
57.68	0.5
59.76	0.7
61.60	0.7
63.52	0.9
65.41	0.7
67.32	0.4
69.21	0.5
71.37	0.6
73.31	0.4
75.15	0.4
77.06	0.3
78.93	0.4
80.94	0.3
82.83	0.3
84.67	52.4
86.75	0.4
88.74	0.4
90.68	1.1
92.57	0.4
94.63	0.9
96.54	0.4

Table D-10. Soil carbonate concentrations for U-3bh-D2 characterization samples

Location: U-3bl-D2	Analysis: Soil Carbonate
Depth (m)	$CaCO_3$ Eq. (wt %)
42.17	11.09
44.30	5.16
45.88	15.57
47.96	0.07
49.92	0.00
51.79	0.00
53.75	1.20
55.69	0.48
57.68	2.60
59.76	8.94
61.60	1.92
63.52	12.81
65.41	0.48
67.32	0.80
69.21	0.61
71.37	3.23
73.31	0.30
75.15	4.76
77.06	8.75
78.93	3.09
80.94	2.08
82.83	3.25
84.67	8.46
86.75	4.33
88.74	1.78
90.68	4.65
92.57	3.91
94.63	5.60
96.54	1.59

Table D-11. Tritium concentrations for U-3bl-D2 characterization samples

Location: U-3bl-D2	Analysis: Tritium	
Depth (m)	Tritium (pCi/L)	Error (1σ) (pCi/L)
42.34	5880	476
44.03	5000	404
45.83	4490	497
48.15	3190	230
49.85	3300	280
51.88	2680	280
54.02	3220	310
55.81	2890	290
57.70	3180	340
59.64	3190	200
61.53	3770	320
63.42	5740	220
65.60	4980	280
67.20	4430	290
69.14	5980	260
71.17	6130	460
73.06	7740	320
75.05	12150	320
76.94	7410	430
79.22	9340	320
81.16	6240	450
82.90	6220	430
84.74	6650	360
86.68	4350	230
88.67	4620	320
90.61	5140	410
92.50	6340	360
94.48	7410	330
96.47	5840	390

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